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THE FOUNDRY TRADE JOURNAL IS THE OFFICIAL ORGAN OF THE INSTITUTION OF BRITISH FOUNDRYMEN AND THE WELSH ENGINEERS' AND FOUNDERS' ASSOCIATION.

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Our Coming of Age.

Last Tuesday saw the coming of age of THE FOUNDRY TRADE JOURNAL. We were reminded of the fact by the receipt of a congratulatory telegram from a reader who has studied every single issue. The then editor reproduced on page 1 a telegram from Vienna quoting Mr. Schwab, the president of the American Steel Corporation, which contained a prophesy of the collapse of the British iron industry. According to the telegram, Mr. Schwab stated that American competition would scarcely hit Continental production, but would ruin the English, and that whilst the American steel trade had trebled its production within the last decade, Britain's was at a standstill or decreasing. After all, there was an element of truth in Schwab's boast.

In the first editorial note, the object for which the Journal exists, was couched in the following phrase:—"Our Journal is instituted to advise foundry-masters of the best means of facilitating and improving the manufacture of castings of all descriptions." We have always borne this in mind, and we sincerely believe that much of improvement in foundry practice during the last twenty-one years can be indirectly attributed to our efforts. The second number (for instance) contained an appeal for the formation of a foundry technical society, which was consistently advocated by the Journal for two years. This propaganda work culminated in the formation of the British Foundrymen's Association, which on receipt of the Royal Charter, changed its title to the Institution of British Foundrymen. In October, 1904, the Journal came into the hands of the present proprietors, and in January, 1921, the Journal incorporated the "Iron and Steel Trades Journal," and commenced publishing weekly. This became immediately an unqualified success, and from then until now continuous progress has been recorded. This remarkable progress during the last two decades is illustrated by comparison with the foundries described at that period and that of Messrs. Schneider outlined in the current issue. In a very large foundry quite comparable with that of Messrs. Schneider, the cupola capacity was 25 tons per hour, whereas that of Messrs. Schneider is 88 tons per hour. In another, then modern foundry, two moulding machines are mentioned. To-day, there are in Europe foundries with two hundred. The number of technical papers on foundry work read in Great Britain in 1904 certainly did not exceed six. Last year the figure undoubtedly exceeded one hundred. On glancing over the first few issues one cannot help being struck by the strong, unpleasant feeling existing between the moulder, his foreman and master. As a sample, we would quote from the issue dated June, 1902. "The average treatment of the moulder by the foreman to-day is enough to drive any one but a moulder off his chump, and the treatment by the employers is, at the best, *nil*." To-day, if a moulder can write M.Inst.Brit.F. after his name, then he meets his employer at institution meetings on level terms, and can rise to any office. But the main point is that such animosity, which was then fairly often expressed, practically does not exist to-day. It is largely due to the Institution which judges a man on his foundry knowledge and personality rather than on any social distinction.

We cannot allow this opportunity to pass without recording our sincerest thanks to the trade, our readers and advertisers. The majority of firms now existing, who advertised in the very first issue, are still regularly using our columns.

As our history is so bound up with that of the I.B.F., it is pleasing to note that we count upon its past-presidents as our best supporters. All except Mr. Pilkington are alive to-day, and all take a very active part in its welfare. For instance, only last Saturday, the first president, Mr. Buchanan, was helping the good work along in Manchester. Last week another past-president, Mr. F. J. Cook, was appointed chairman of the Research Committee of the B.C.I.R.A., whilst a third, Mr. Oliver Stubbs, was elected chairman of the executive committee of that body. Still another past-president, Dr. Percy Longmuir, has recently been elected director of research for the industry.

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Correspondence.

[We accept no responsibility for the statements made or the opinions expressed by our correspondents.]

Plumbago, Graphite and Blacklead.

To the Editor of THE FOUNDRY TRADE JOURNAL.

SIR,—In your issue of December 14, under the heading of "Some Tests for Foundry Sands and Their Practical Application," by W. West, A.M.I.Brit.F., and under the particular sub-heading of "Blackings or Graphite Facings," the writer referred to, has given some excellent advice and information on this matter, but there are one or two observations which, we think, in the interests of all users of this commodity, require a little correction.

He states that graphite is unquestionably the most important of the three allied commodities—plumbago, graphite and blacklead—but we venture to state that this is incorrect. Without doubt a pure Ceylon plumbago is the most important of the three, because it is the purest in carbon, the most expensive, and its physical properties will give infinitely better results, at least for general purposes, than any other-origin material.

Originally, the finest plumbago came from Cumberland, but only in very small quantities, which analysed as high as 99 per cent. purity, but the great source of supply for many years past has been the Island of Ceylon, which runs in purity from 50 per cent. up to 98 per cent. carbon.

The greasy properties of a graphite are not to be compared with the natural, greasy and oily properties of a Ceylon plumbago, which is world-renowned. Until a few years ago no crucible manufacturer would have thought of using any other material than a pure Ceylon plumbago for the manufacture of crucibles, owing to its high refractory quality, and this we maintain would hold good to-day were it not for the fact that flake graphite is produced to-day under easier conditions and is more accessible in its natural state than is Ceylon plumbago, with the consequent result that it has forced its way into the market more on account of cheapness than on account of its physical properties, which indeed are not equal to the Ceylon product. No Ceylon mineowner would think of calling Ceylon plumbago Ceylon "graphite." The former is the parent of the latter, or, better still, the latter is an offshoot of the former, but many users, and even firms in the trade, confuse a graphite with a plumbago and vice versa; in fact, even going so far as to call a blacklead a graphite or a plumbago.

With regard to the cited paragraph of this article, in which Mr. West states "it can be discerned that paying for silica or sand at graphite rates is a factor to be avoided," we, as one of the largest wholesale importers in this trade, are indebted to him for this observation, because it is a point which we, as specialists, have been endeavouring to bring home to users of this article for many years past.

It is a peculiar fact, but nevertheless true, that very few dealers, much less users of this commodity, have any expert knowledge of this article, but if users are content to accept margarine when they ask for butter, it is little to be wondered that they cannot get the best results and their manufactures suffer in consequence.

When we offer the pure article or a material which contains sufficient carbon—which is a necessity if a decent casting is to be produced—we are very often confronted with a "faked" or "mixture" graphite, which has been so cleverly manipulated and mixed with cheap "foreign" substitutes as entirely to deceive the purchaser into the belief—from a visual point of view—that he has bought something very cheap. It is not until a practical test has been made with this "refuse" that he realises that a fine casting is an impossibility when its principal ingredient has been impoverished and weakened to such an extent that only 40 per cent. of carbon and even less is the result.

It will therefore be seen that no difficulty presents itself to users of this commodity who are willing to pay a little more for a pure plumbago or graphite, thereby ensuring infinitely better results, if they will only specify to suppliers in their requisitions that a specific graphitic carbon contents is required, taking into consideration the particular article they wish to produce.

By this stipulation they can protect their interests, but at the same time it must not be overlooked that the grinding process enters into this question considerably. A Ceylon plumbago or graphite can be considerably lowered or enhanced in value by the grinding, and it is hardly necessary to state that to get the best results, special machinery must be employed whereby every particle of grit is entirely eliminated, thereby ensuring that the oily, greasy properties will predominate in use over the foreign impurities, such as silica, iron compounds, etc.

Yours, etc.,
T. S. WILSON & Co.

9 and 10, Great Tower Street,
London, E.C.3.

Defects in Baked Enamels.

BY G. W. WALKER.

Certain peculiar defects having appeared in enamelled automobile fenders, an investigation was made to determine, if possible, the cause of these defects. Not all the fenders in the same lot showed the defects—which consisted of lines, some long, others short, in the otherwise bright and uniform surface of the enamel. Along these lines the enamel was "dead"—that is, without lustre—and had an appearance as if a thread had been drawn over the wet enamel. These defects appeared through two coats of enamel when baked on.

When the enamel was carefully removed from such lines by use of a solvent, no defect could be found in the metal beneath even on magnification. It was suggested that the metal was "porous," but photo-micrographs failed to reveal any pores.

It was noted that these defects generally appeared on certain parts of the fenders and more generally near the crown.

On following through the various operations preparatory to enamelling, it was found that an air hose with a brass nozzle was used in the final cleaning operations just previous to enamelling. At times the workman would touch the fender with this nozzle, sometimes drawing it along the surface. To test the matter, a fender was selected and the nozzle was drawn several times across the surface. All of these lines appeared in the finished fender, showing through two coats of enamel, with the same appearance as before noted.

The same results were obtained in laboratory experiments. When the corner of a piece of brass was drawn with comparatively light pressure across a piece of sheet metal, which was afterwards enamelled and baked, the lines appeared through the enamel.

It would appear that small particles of brass worn off by abrasion against the harder sheet metal were sufficient to cause the above defects, but a magnification of 150 diameters failed to reveal any particles. However, when an iron nozzle was substituted for the brass one, the above defects disappeared.—*Chemical and Metallurgical Engineering.*

Death of Mr. Ambrose Firth.

Mr. Ambrose Firth, Chairman of the Brightside Foundry and Engineering Company, died last Thursday at Bournemouth, in his seventy-seventh year.

Mr. Firth's eldest son, Mr. Tom Firth, is a past-President of the Institution of British Foundrymen, and to him and his family we offer, on behalf of the foundry industry, our sincerest sympathy.

Mr. Ambrose Frith was born at Grimesthorpe in 1845, and started business on his own account in 1865. The first week's wages bill was only £6. In those days the casting of a 20-ton hammer block was considered of great importance. To-day the same firm specialises in large castings, and recently we illustrated a 112-ton casting. This clearly shows the progress made by the firm under the guidance and practical experience of the head of the firm.

The Foundry Cupola.

By Robert Buchanan (Birmingham), Past President of the Institution of British Foundrymen.

(*Continued from page* 28.)

Charging the Cupola.

Many cupola-men make the mistake of overburning the bed before making up the bottom door and beginning charging.

The bed requires to be kindled as high as the tuyeres, and that only, and charging the iron may begin. The pig-iron, which has been broken into four pieces, if for a cupola of under 30 in. dia., is weighed and charged into the cupola. It is a good plan to put a thin layer of scrap on the top of the bed to keep the relatively heavy pig-iron from crushing the upper layer of coke. Then, after the pig-iron, the remainder of the scrap is charged and evenly distributed over the cupola. On the scrap is now placed the charge of coke, also evenly distributed. Some limestone to flux the ash of the coke and the sand adhering to pig-iron or foundry scrap, is now added. Some cupola-men, however, do not begin adding limestone until the first charge after the cupola is filled up, but the author fails to see any advantage in this.

The charges, as stated, are continued until the cupola is full to the charging door. It is important that the coke occupies a distinct stratum between the charges of iron, as only by this means is the bed kept level as melting proceeds. Projections inside the cupola may also tilt a part of the charge, and so cause an irregular descent to the melting zone. Level charging and a level descent of the charges go a long way towards satisfactory melting. When the cupola has been charged to the charging door, the blast may be put on as soon as is convenient. Some people advocate a period of one or two hours as a proper time to elapse between finishing charging and putting on the blast.

No inconvenience whatever has been found in blowing as soon as charging is finished, if the bed is kindled to the tuyeres, and no cupola should be charged unless it be kindled to the tuyeres. Blowing quickly after charging will give hotter first metal than what is got with a longer interval of time. When the coke is called upon to give up its heat it should do so rapidly, and with its whole vigour, and should not be employed in "warming the charge," as it is termed.

The quantity of coke put on between the charges should only be sufficient to keep the bed level with the top of the melting zone. When a charge of iron has been melted, and the layer of coke has followed down by reason of the weight of iron and coke on top of it, if the coke be too great in quantity, and more than replaces the coke consumed in melting the iron just liquified, the result is a partial cessation of melting.

The metal should now be of a regular heat, quickly and economically melted. When melting down the last two charges of iron reduce the blast to half-pressure. It does not retard the melting appreciably, but saves the coke remaining in the cupola, and avoids wasting the lining. More linings are wasted in the last 15 minutes' blowing than for hours previously.

Charging a 36-in. Cupola having a Drop-Bottom and Receiver.

The cupola to be considered has an inside diameter of cupola 36 in., contracted to 19 in. at bottom. Its height from the bottom plate to the charging door is 15 ft. It is provided with two rows of tuyeres of 78 sq. in. total area, and it melts over 4 tons per hour, and 20½ tons have been melted in it in one afternoon. Each cupola has a separate hearth or receiver for collecting the iron as it is melted. From the receiver the metal is tapped into the ladles.

The system of charging may be best followed by beginning at the bottom of Table II. and reading up:—

TABLE II.—*Order of Charging 36-in. Cupola.*

Charge.	*Notes.*
1 cwt. coke 10 cwt. iron	And so on until after the second last charge of iron, when only 56 lbs. coke is used.
1½ cwt. coke 10 cwt. iron	Cupola full to charging door when 50 cwt. of iron is in.
10 cwt. iron 1½ cwt. coke	
10 cwt. iron 1½ cwt. coke	Blast pressure 8 to 10 ozs.
10 cwt. iron 1½ cwt. coke	24 to 28 lbs. of limestone put on top of each charge of coke.
10 cwt. iron Bed 5 cwt. coke	

The average expenditure of coke over a period of one month is as follows:—

For light castings, 1 lb. of coke melted 7.87 lbs. of iron.

For heavy castings, 1 lb. of coke melted 10.00 lbs. of iron.

Average for month, 1 lb. of coke melted 8.49 lbs. of iron.

Metal appears eight minutes after the blast is put on, and is hot enough throughout the melt to run castings sometimes under one-eighth of an inch thick, moulded and cast at a distance of about 250 ft. from the cupola.

One can judge from the time of the appearance of first iron whether the bed of coke is the proper height. If first iron is seen in 5 minutes the bed of coke is too low. If 15 minutes elapse the bed is too high.

Melting Ratios.

This is a subject which probably interests foundrymen more than any other, and in regard to which there is considerable romancing by cupola makers and some others.

Some of the absurd claims as to economy of fuel would only be fitted to make one smile did one not know that these questionable statements too often mislead to a serious extent people with capital invested in foundries. Their acquaintance with melting is not such as enables them to judge of the case, and so they accept these statements as authoritative. Such misleading claims only cause trouble and annoyance for people who have the melting to do, and disappointment for those who employ them.

When absurd claims are made, say, of melting 16 lbs. of iron with 1 lb. of coke, one wonders what was done with the metal when it was melted. Did it run castings? That was the object for which iron was melted. What was the proportion of waster castings? It is as important to know the answer to these questions as to know the proportions of iron and coke. We believe metal may be melted in the ratio stated, but we do not believe the castings of an average foundry can be run with the metal. What, then, is a good, that is, an economical, ratio of coke and iron? It cannot be stated in one word. What is good and economical melting under one set of conditions may be waste under another set of conditions. Condition of cupola, volume of blast, quality of coke and of the iron to be melted, kind of castings to be run, and distance the metal has to be carried are all important matters affecting the answer. The quantity of iron to be melted is an important factor.

An economical melting ratio is one which, under the prevailing conditions, shall produce with the smallest quantity of coke metal suited for the work to be cast.

Can all cupolas as now worked be considered as having economical melting ratios? Investigation would show, we have no doubt, that the number on which no improvement may be made is a small minority.

Effect of Cupola Melting upon the Iron.

That iron undergoes some changes other than being melted in its passage from the charging door of the cupola to the foundry ladle, is known to most founders.

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Silicon always becomes oxidised to some extent, losing 0.20 to 0.30 per cent. each time the metal is melted.

Manganese loses on an average 0.093 per cent. each time the metal is melted. The smallest loss the author has observed is 0.056 per cent., and the greatest 0.134 per cent.

Phosphorus goes through the cupola practically unaltered in quantity. The only phosphorus which passes into the slag seems to be that present in the iron which is oxidised, and goes into the slag, taking its phosphorus with it.

Irons containing 1 per cent. and over of phosphorus have great fluidity and running power, so that thin castings may be run with an iron of this character with great facility. The fluidity and running power of such iron is due to the low melting point of phosphide of iron, which is the condition in which phosphorus is present in iron. This melting point is several hundred degrees of temperature under that of the iron which envelops it, and through which the phosphide is interspersed. At the moment the iron melts the phosphide has risen several hundred degrees above its melting point. This fact supplies the reason why phosphoric irons run with such fluidity; the phosphide having to cool down through many degrees of temperature lower than the "setting" or freezing point of iron free from phosphorus before reaching its "setting" or freezing point. The cooling action of a mould has thus an effect on low-phosphorus iron which it fails to have on phosphoric iron. Iron containing phosphorus is thus easier melted than non-phosphoric iron, because it melts and is fluid at a lower temperature.

Cupola Melting Causes Sulphur.

Sulphur is the source of much trouble to the ironfounder, hardening castings very considerably if 0.14 per cent. be present.

Coke, with sulphur averaging 0.769 per cent., increased the sulphur in the castings by 0.038 per cent. on an average of twelve meltings. The minimum increase was 0.020 per cent., and the maximum 0.079 per cent.

As sulphur increases in the coke so will it increase in the casting. The importance, therefore, of using coke with little sulphur cannot be too strongly emphasised.

If the cupola is melting dull iron a greater proportion of sulphur goes into the iron than when melting hot. The first iron from a cupola, not being so hot usually as that melted later, is higher in sulphur, and so such iron is poured into castings requiring little or no machining. If the cupola melts dull all through the cast, then the iron will from this cause be hard all through the cast. This absorption of sulphur by dull iron is evidently due to the slag being viscous or pasty, and in such a condition has a feeble combining or basic effect on the sulphur. Slag has a higher melting point than iron. The iron, on melting, combines with the sulphur, forming sulphide of iron, at a temperature under that of fluid slag. If hot melting be done, the sulphur passes into the slag in greater proportion, not because the iron is hot, but by reason of the slag being fluid, and so intimately comes in contact, and combines with, the sulphur-bearing ash of the coke. Thus it is that hot melting makes soft castings.

Total Carbon is Influenced.

The amount of total carbon to be found in the metal when cool will largely depend upon the quantity of coke used in melting, and whether there is a proper quantity of blast used.

If the bed of coke and the charges of coke between are lean, and a large quantity of blast be used, then the amount of total carbon in the melted iron will be less than when the iron was charged. The castings will also be harder, because the amount of free carbon, or graphite, will be less.

It is obvious that the way to soften castings which have been hard from lean coke and a strong blast is to increase the coke or soften the blast. On the other hand, to prevent "kish" or obtain closeness or density of metal, lessen the charges of coke, or increase the blast. One other way to lessen the probability of "kish" appearing in the casting is to cast *hot*.

The reason for casting hot is that hot iron will hold the carbon more strongly dissolved in it than when it is cooler. If iron rich in carbon is held in the ladle before pouring, then some of that carbon will free itself from the metal, although the iron is still fluid. This carbon, which has been set free too soon, washes into one or more places and appears as so much "kish" or dirt. This is quite an important cause of loss and disappointment, and can be readily remedied by the means indicated.

Blow-Holes.

One other important effect of hot melting and pouring is that if the iron is poured into the mould while the metal is still hot the contained gases are held strongly dissolved in the metal. If the iron is cast too hot, then the gases gather together and appear as blow-holes. These blow-holes are small, and differ in appearance from those caused by a faulty mould. If hot pouring is used, then small blow-holes will appear much less often than they do now. Better have a rough casting than one with blow-holes.

Cupola Slag.

There is a section of cupola practice which has not had the attention it deserves. There is more iron, not visible to the eye, carried to the rubbish heap than most people imagine. So long as cupolamen get a fluid slag, the iron chemically combined with the slag does not concern them, principally for the reason that few of them know there is iron in the slag unless it be visible. Slags may contain over 10 per cent. of iron. The lowest quantity of iron in any slags the author analysed being 1.9 per cent.. and the highest 10.10 per cent.

Taking nine analyses of slag, some of which analyses were averages of three or four meltings, and would thus represent about twenty meltings, results showed that they contained on an average 4.960 iron, 0.270 sulphur, and 0.049 per cent. phosphorus Silica averaged 57 to 58 per cent., and was the product of sand adhering to the pig-iron and foundry scrap, and also from the lining of the cupola.

When iron is being melted dull, that is, coming out of the cupola at what may be termed the "red-molten" condition, a greater quantity of sulphur goes into the iron than when hot melting is being done, this being due to the formation of sulphide of iron at a temperature at which the slag was pasty or only partially fluid. Although slag has been fluid in the cupola, and has taken up the normal quantity of sulphur, if it be allowed to cool in contact with iron it will give up a proportion of sulphur to the iron. Some iron, allowed to cool under slag during a period of 120 hours, had the sulphur increased from 0.107 per cent. to 0.153 per cent., an increase of 43 per cent. At the same time combined carbon had decreased from 0.508 to 0.020 per cent.

There is thus a temperature, which, for want of more precise data, may be called the "red-molten" condition of iron, at which the slag has a lower combining-power for sulphur than what iron has. And also there is a temperature at which, though the slag has already combined with the sulphur, it will pass some of the sulphur into the iron if they be cooled in contact.

Melting-hot is thus the means to adopt for best results, both in quality of iron produced and in fluidity, by which the various castings may be run, each at its proper temper. If metal is produced of equal quality and fluidity each day, with a moderate expenditure of fuel, then one may conclude that intelligence and skill are directing the operations of the cupola. If, on the contrary, there is hot metal one day and dull metal the next, and this is almost always accompanied by an extravagant use of coke, it may be concluded that there is someone about who does not know how to work the cupola.

In foundries, as in so many other businesses, the great failing, greater even than the want of ordinary education, is the want of the observing-eye and the inquiring-mind. With these three combined, in the operations which have been described, one may find a source of continual interest, of delightful and profitable study.

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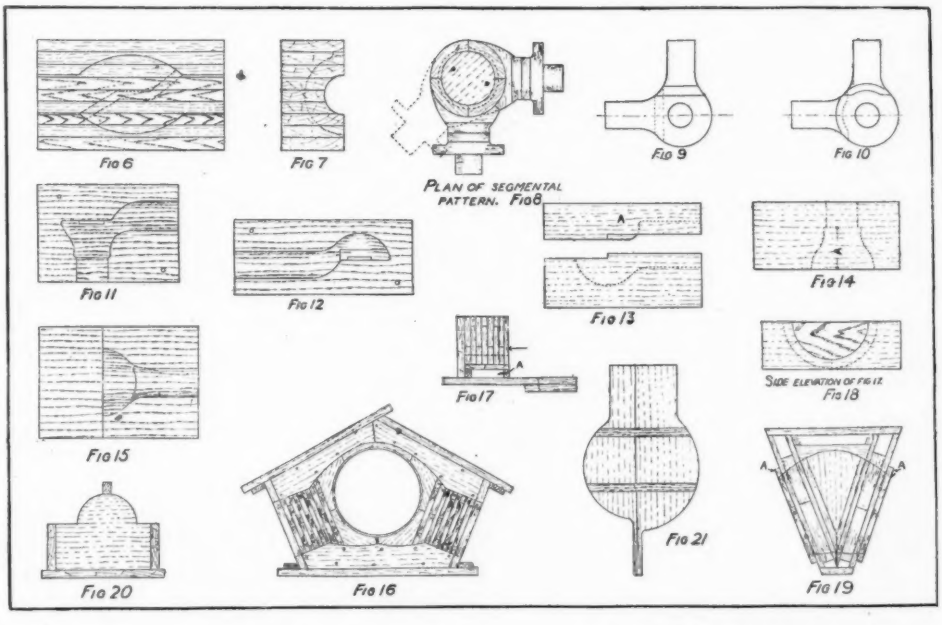
An Apprenticeship Course in Foundry Practice.—XXVI.

By Ben Shaw and James Edgar.

THE CONSTRUCTION OF CORE-BOXES. Part II.

Globe-Valve Core-Boxes.

What are called globe-valve core-boxes are among the most difficult small boxes which the patternmaker has to make, and from them the apprentice can learn much. Of course, in motor engine work there are carburetter and other boxes which are very intricate, but globe valves are made in most patternshops. The general term, "globe-valve," does not convey any meaning as to the purpose for which the valve is to be used, nor is it descriptive of its characteristics. Thus globe-valves may be stop valves or screw-down valves. But, because it is only an indication of the shape of the valve, it is a more useful term in the patternshop and foundry than in any other department. There are variations, but a globe-valve is generally understood to be a valve with an elliptical or oval body from each end of which there is an outlet and inlet branch respectively. These branches may be on the same centre line, in which case the valve is described in workshop parlance as a "through-valve." They may be at right-angles to each other, when the valve is called a right-angled valve, or they may be inclined to each other at a less angle than 90, when they are simply termed angled valves. They range in size from ½ in. to 24 in. or more, and in internal design there is considerable variation, sometimes determined by the work for which the valve is going to be used, and sometimes because of the ideas and experience of the designer.



Different Districts, Different Methods.

In different districts the methods of making the core-boxes for these valves vary. For instance, the core is frequently made in two or more boxes, and where one box is used two cores are sometimes made and connected by a print in the valve seat. The smaller sizes we shall not consider, but Figs. 6 and 7 show the best method of building a medium-sized core-box. It may be cut in several ways. Sometimes a globe-shaped block is turned in the lathe, and this is used as a template, then, after it is bedded into the box, the valve seat with division plates is cut from it. This is a slow and clumsy method. The easiest way, and one that is quite accurate, is to gouge the end shapes to size and use a template bearing on them as described for the valve shown at Fig. 4. The valve seat for small valves may be turned out of hardwood and fitted in position, and in medium-sized valves the division plates may be made separately and screwed to a centre plate. The division plates are frequently not radial, and the box may be conveniently made so that the core will be in halves, which are afterwards secured together, the division plate in this case being as indicated by the dotted lines in Fig. 6. A simple and effective way of fitting the seat and division plates, and one which is applicable to much core-box work, is to set out the shape of the plates on a drawing board, to erect grounds representing the shape at the ends of the cores, and, after tacking the seat to the board, to use a template which will define the fitting shape. With large valves having seats of this design, it is necessary to dovetail the division plates to the seating plate.

Small Angled Valve Core-Box.

Fig. 8 shows a small valve of the angled type, and because of the branches not being in the same straight line, there are important modifications in the construction of the core-boxes. These are not really more difficult than those for through-valves, but the apprentice frequently fails in visualising the finished casting. After all, the ribbing inside the box is simply to divide the valve-chest into two chambers, and it is helpful for the pattern-maker to think of an angled-valve as a through-valve, twisted round until the branches are at an angle to each other, and consequently the plates connecting the seat to the outer metal must also be twisted, the seat being in a fixed position. The division plates in these valves are of varied design, as with the ordinary through valves. It is as well and almost necessary with these valves, when small, to make two core-boxes, one below and the other on top of the valve seat. The timid craftsman will make innumerable templates to make sure of his shapes, but others no less accurate will depend more upon their judgment and observation. Figs. 9 and 10 show two designs of division plates, and the boxes for Fig. 10 would be made different from those suitable for the design shown in Fig. 9. They are similar, in that the two cores are often connected by a circular core in the centre, which necessitates a print being placed in each box. Some variation is necessary in the form of the prints in order that the coremaker will not make a mistake when

C.

fitting the core, a common method being to form a flat on these prints. Figs. 11 and 12 represent suitable core-boxes for the valve Fig. 9.

When the plates are circular (Fig. 10) it is much better, although not absolutely essential, to joint the core on the plane of the valve seat. If this is not done, loose pieces have to be put in the box. Fig. 13 is a view of the bottom box. A drop in the box joint is advisable, because the round core must be jointed on the centre line, and if the box is not dropped on the centre line of the valve seat, it is rather a clumsy job to fit a thickness, corresponding to the thickness of the full diameter of the seat, that is, under the centre. The joint being dropped, only half of the seat has to be screwed against the cheek (A, Fig. 13). The view Fig. 15 explains clearly what is meant.

Fig. 14 is an outside view of the other core-box with that part of it which can be turned, dotted. This shape can be quickly bored on a machine, but very nearly as quickly turned in the lathe. It is rather deep to turn the full depth, the diameter being small, but the distance A can quite easily be turned. In making the boxes for these valves the shape of the centre core, that is, the shape through the valve seat, is sometimes cut out of one box, being made deep enough to allow of a print being put in the other box, and this method certainly has the advantage that two cores always have over three. In other words, the more joints there are in the core, the greater is the tendency to "grow" in assembling the different parts.

Large Angled Valve Core-Box.

Apprentices and young journeymen may successfully cope with small jobs but be beaten by large work of the same design. So much can be learnt from globe-valve core-boxes and they afford such a splendid opportunity of demonstrating large and small construction of the same design that it will be worth while describing a box for a large angled valve. Fig. 16 is a joint view of perhaps the best box that can be made for such a job as it comprises the three essentials for a large core-box as for a large pattern; it is accurate, it is strong and it is light. The branches for such a box ought to be built, and as the branch half-diameter is not nearly the depth of the box, a platform like A, Fig. 17, should be made. It consists of a flat plate resting on two "legs," and there is no need for shouldering the legs into the plate, as the platform will be covered up when the box is finished, and thus cannot be knocked. The segmental ring should have a front plate screwed to it (Fig. 18) and flush with the end of the platform. Instead of a segmental ring for the centre, core blocks should be made of timber conveniently jointed and glued. These blocks can be cut with templates. Although it is possible to do without joint plates in a solid box, they are an advantage. It is never wise to have the face of a core-box in many separate joints if it can be avoided, because the coremaker cannot be expected to make a decent joint if the surface of the box is irregular, and when end-grain and side-grain are on the same face it does not long remain straight.

The top half of the core-box (Fig. 19) should not present much difficulty. Here again we must have an outer frame screwed to a bottom. The centre portion can be built in a fashion similar to the same portion of the pattern. Considerable parts of the branch-cores have to be carried in this box, so that it will have a reasonable bearance on the bottom half-box. It will be noted that a segment to form a runner for a strickle is screwed on the outsides of the box at AA, Fig. 19. This serves the double purpose of a guide for the strickle and a support for a centre piece to which the ribs which support the valve seat can be screwed. The ends of the box (Fig. 20) are shaped so that the strickle and the rib support bear on them. The plate for the valve seat, because of its size, will probably have to be jointed of two widths, but, whether it is in one or two pieces, it is good practice, in order to keep it from warping, to inset two hardwood battens (Fig. 21). This plate can be dowelled on the box-joint. The circular ribs would be built of segments or of narrow staves fastened to the seat.

The Magnetic Susceptibility and Iron Content of Cast Red Brass.*

The presence of iron in commercial brass is often objectionable, particularly if it occurs as discrete, poorly-alloyed particles. In order to obviate any such harmful effects, a very low ferrous content is frequently specified. Therefore, a rapid, non-destructive method for quantitatively determining its presence would be of great value in practice. A magnetic method of inspection would fulfil the requirements of such a test if a definite relationship exists between some magnetic property and the iron content of the metal. From the meagre information available in the literature it was evident that this matter had received little attention.

With these facts in mind, a study was made of the magnetic properties of cast tin red brass contaminated with iron. A series of seven samples of an alloy of the type 82 copper, 15 zinc, 3 tin was prepared, containing various small proportions of iron up to 0.75 per cent. These specimens were magnetised in a suitable solenoid. A test coil of 1,200 turns extended over two-thirds of the specimen, and readings of the magnetic induction were taken by means of a ballistic galvanometer. Greater precision was secured by balancing out the magnetising force by means of a variable mutual inductance, so that the galvanometer deflection, in each case, was a measure of the increase in flux density due to the specimen (metallic induction).

Magnetic properties were determined in the cast condition, and after annealing 15 minutes at 625 deg. C., 8 hours at 800 deg. C., and 16 hours at 800 deg. C. for different values of magnetising force up to 500 gilberts per cm. The microstructure of the metal was determined before and after these various heat treatments. The cored structure of the cast material largely disappeared after the first eight-hour anneal. The eutectoid present in the cast samples was likewise absorbed at this time. The second eight-hour anneal caused no further change in structure. Oxide inclusions were present in all of the samples. Up to 0.14 per cent., the iron went into solid solution in the matrix of the alloy, but larger amounts than this caused the appearance of pale, rounded areas of an iron-rich constituent. A rough estimate of the iron content could be made from the number and size of these areas. The percentage of iron present had no noticeable effect on the grain size of the metal, nor did the grain size have any definite influence on the magnetic properties of the specimens.

The data obtained revealed several interesting points. For instance, the magnetic properties are not a precise index of the iron content of the cast metal. Then the magnetic susceptibility is markedly affected by changes in physical condition produced by heat treatment. Even after the material has been thoroughly annealed, there is still no simple relationship between the magnetic susceptibility and the iron content. The seeming irregularities in the magnetic behaviour of these brass samples was probably due, in the case of the cast specimens, to the unhomogeneous structure of the metal, while those of the annealed bars were caused by the presence of the iron as two modifications, the dissolved and the segregated. The iron content was the source of the magnetic effects observed.

Australia: 48-Hour Week.—While the boilermakers, sheet-metal workers, and ironworkers' assistants in New South Wales are strenuously opposing the re-introduction of the 48-hour week, the members of the Stovemakers' Union, who struck against the longer working hours, have returned to work. Eight out of twelve shops affected are now working the 48-hour week. In a statement of the position the secretary of the Metal Trades' Employers' Association of New South Wales said that the industry for the past twelve months had been in a somewhat precarious condition, and the outlook for employment had been dark. With the advent of the 48-hour week, however, many employers reported that inquiries for machinery had become more frequent. There seemed every prospect of a revival of trade.

* Abstract of Technology Paper, No. 221, of the American Bureau of Standards, by L. H. Marshall and R. L. Sanford.

American Safety Code for Foundrymen.

The American Foundrymen's Association and the National Founders Association (American) have published a "Safety Code for the Protection of Industrial Workers in Foundries," which is now the tentative American standard, having been approved by the American Engineering Standards Committee. The following includes the more important phases enunciated :—

Introduction.

Scope.—This code deals with foundry conditions only, omitting such subjects as building construction, exits, stairways, elevators, lighting, sanitation, etc., as these subjects are covered by other codes.

Applications of Regulations.—Regulations affecting industrial establishments generally in respect to the safeguarding of transmission machinery, miscellaneous machinery, elevators, stairways, platforms, or relating to sanitary conveniences and first-aid equipments, not included in this code, shall apply with equal force to foundries.

Definitions.

Foundry.—A foundry shall mean a building where iron, steel, tin, zinc, lead, aluminium or compositions containing any of the baser metals are melted and poured into moulds for the making of castings, and shall include all moulding, core-making, melting, cleaning, toilet and wash-rooms used in connection therewith.

Entrances or Exits.—The term "entrances" or "exits" shall mean passages for common use between the foundry and the open air, provided for employees during working hours.

PART I.—PLANT LAYOUT.

Entrances.

Protection.—Entrances to foundries located in cold climates shall be protected during the winter by covered vestibules or their equivalents, which shall be so constructed as to eliminate harmful draughts, and of such dimensions as to answer ordinary purposes, such as the passage of wheelbarrows, trucks and industrial cars. This shall not apply to entrances used for railroad or industrial cars handled by locomotives, or for travelling cranes, horse-drawn vehicles or automobiles; these entrances may remain open during the winter only for such time as is necessary for the ingress and egress of such cars, cranes, horse-drawn vehicles or automobiles.

Floors, Pits and Galleries.

Floor at Cupola.—The floor beneath and immediately surrounding a foundry cupola shall be kept free from collection of water.

Cleaning and Finishing Floors.—All cleaning and finishing floors shall be cleaned and levelled as often as necessary to secure safe working conditions.

Floor Adjoining Tracks.—The floor immediately adjoining industrial tracks over which workmen frequently pass shall be reasonably hard and flush with the top of the rails. Sufficient clearance for easy passage of truck wheels shall be provided between floor and rails.

Pits.—All pits or openings located in foundry floors shall be guarded by suitable coverings or railings where practical; where impractical, a watchman should be provided.

Galleries.—Galleries where molten metal is poured into moulds shall be provided with a solid partition of fire-resisting material not less than 3 ft. 6 in. high, installed on open side of such gallery.

Gangways.

Definitions.—The term "gangway" shall mean a well-defined passageway dividing the working floors of a foundry. The width of a gangway shall be understood to be the clear distance between moulds, posts, partitions or other obstructions on one side of the gangway and similar objects on the other side.

General Gangways.—Gangways other than those for carrying molten metal shall be of sufficient width to allow the passage of employees and materials, and shall be illuminated in accordance with the requirements of the Factory Lighting Code.

Condition.—Every gangway in which molten metal is being handled shall, during the progress of pouring, be kept in good condition, clear of obstructions and free from undue dampness.

For Crane, Trolley or Sulky Ladles.—Gangways where molten metal is carried in crane, trolley or sulky ladles shall be sufficiently wide to allow employees safety to handle and empty the ladles.

For Truck Ladles.—Gangways where molten metal is carried in truck ladles exclusively shall be not less than 18 in. wider than the extreme width of the truck ladle.

For Crucibles.—Gangways where molten metal is carried in crucibles by not more than 2 men per crucible and poured into moulds placed on one or both sides of the gangway shall be not less than 3 ft. wide. Gangways where molten metal is carried in crucibles by more than 2 men per crucible and poured into moulds placed on one or both sides of the gangway shall be not less than 4 ft. wide.

For Hand Ladles.—Gangways where molten metal is carried in hand ladles by not more than 2 men per ladle and poured into moulds placed on only one side of the gangway shall be not less than 3 ft. wide. Gangways where molten metal is carried in hand ladles by not more than 2 men per ladle and poured into moulds placed on *both* sides of the gangway shall be not less than 4 ft. wide. Gangways where molten metal is carried in hand ladles by more than 2 men per ladle shall be not less than 5 ft. wide.

Aisles.

Definitions.—The term "aisle" shall mean a passageway between moulds leading from the gangway. The width of an aisle shall be understood to be the clear distance between moulds, posts, partitions or other obstructions on one side of the aisle and similar objects on the other side.

Condition.—Every aisle in which molten metal is being handled shall, during the progress of pouring, be kept in good condition, clear of obstructions and free from undue dampness.

For Hand Ladles or Crucibles.—Aisles where molten metal is carried in hand or bull ladles or crucibles and poured into moulds on individual floors by not more than 2 men per ladle or crucible shall not be less than 12 in. wide except where moulds alongside the aisle are more than 20 in. high above the aisle level, in which case the aisle shall be not less than 24 in. wide. Aisles where molten metal is carried in hand ladles or crucibles and poured into moulds on individual floors by more than 2 men per ladle or crucible shall be not less than 36 in. wide.

For Crane, Trolley or Sulky Ladles.—Aisles where molten metal is carried and poured into moulds on individual floors by crane, trolley or sulky ladles shall be sufficiently wide to handle safely and empty the ladles.

PART II.—MACHINES AND EQUIPMENT.

Equipment.

Slag Spouts.—For protection against the spattering of slag, slag spouts should, where practical, be equipped with suitable shields.

Lip-Pouring Ladles.—All lip-pouring ladles of 1,000 lbs. capacity or more shall be equipped with a worm gear or other self-locking device.

Crane, Truck and Trolley Ladles.—All crane, truck and trolley pouring ladles shall be equipped with a dog to prevent premature overturning and shall be so constructed that when they are full of metal the centre of gravity shall be below the centre of the trunnion, unless each ladle is equipped with a gear mechanism and a latch, either of which will prevent premature overturning of the ladle.

Single Shank Ladles.—All single shank ladles should be provided with sheet metal shields.

Crown Plate of Furnace.—Where the crown plate of an upright crucible furnace is elevated above the surrounding floor in excess of 12 in.,

the furnace shall be equipped with a platform having a standard rail; such platform shall be constructed of metal or other fireproof material, and shall extend along the front and sides of the furnace, flush with the crown plate, and shall be clear of all obstructions. If the platform is elevated above the floor in excess of 12 in., the lowering from same of crucibles containing molten metal shall be by mechanical means.

Sand Buckets.—Equipment for the movement of materials by overhead cranes, such as sand buckets, shall have a factor of safety of at least 5, including bolts where used. When buckets have movable bails, safety locks or catches shall be provided, and the use of such safety locks or catches shall be enforced. Substantial steel handles shall be provided on grab buckets to afford safe means of pulling or prying apart the jaws in case cylinders stick.

Sling Beams.—Sling beams shall be so constructed that the slings cannot be jarred off the beam, and so that the slings can be readily moved to accommodate different size flasks.

Trunnions on Flasks.—Trunnions on flasks hereafter constructed shall be carefully designed for the loads they are to handle and constructed with a factor of safety of at least 10, including bolts where they are used. The diameter of the button shall be equal to the diameter of the groove, plus 1½ times the diameter of the sling used to handle the flask. Inside corners shall be well filleted, and in order to prevent the sling sliding off or riding the button, the radius of the corner between groove and button shall be approximately equal to the radius of the sling used, the remainder of the inside edge of the button to be straight.

Slings.—All slings used to suspend flasks from jib crane beams shall either be so designed that there are safe clearances for a hand grip or handles shall be provided to hold the sling.

Finishing and Cleaning.

How Cleaned.—Where castings are cleaned or chipped in moulding or casting rooms, there should be provided suitable screens, partitions or other effective means to protect employees against flying chips and excessive dust. All castings shall, where practical, be cleaned or chipped in rooms separated from rooms used for other purposes.

Finishing Rails or Benches.—Where finishing rails or benches are used, they must be sufficiently far apart to allow the operators to pass between them without being endangered by falling castings.

Dry Tumbling Mills.—In new installations where dry tumbling mills are used within a foundry, exhaust apparatus shall be installed and operated that will effectively draw off the dust created by the operation of such mills; in existing installations such mills may be enclosed in reasonably dust-tight compartments while in operation. Tumbling mills, when not enclosed, shall be provided with substantial guards on open sides when in operation.

Dry Grinding, Buffing or Polishing Machines.—Where dry grinding, buffing or polishing machines are used, an exhaust apparatus or its equivalent that will effectively remove the dust created by the operation of such machines shall be installed and operated. This rule shall not apply to floor or bench stands used specially for tool grinding nor to portable grinders.

Swing Frame Grinding Machines.—Where swing frame grinding, buffing or polishing machines are used, screens shall be provided when necessary to protect adjacent workmen.

Sand Blasting.—Sand blasting by hand-operated apparatus shall be carried on in suitable sand blast room or outside the foundry, and in both cases effective means shall be provided to protect passers-by from the sand blast. Dust shall not be exhausted into the open air, but into a collector.

Arc Welding.—A guard or shield shall be provided where necessary to protect other workers from exposure to the radiation from the electric arc, and no employee shall be required to work in such a position that his face is exposed to such radiation from any neighbouring source.

It is recommended that permanent inclosures be supplied where practical for arc welding and cutting.

PART III.—LIGHTING, HEATING AND VENTILATION.

Lighting.

Lighting.—The light in every foundry shall be in accordance with the requirements of the Factory Lighting Code.

Heating.

Working Temperature.—A comfortable working temperature shall be maintained during working hours in all sections where employees are regularly working.

Salamanders.—Salamanders shall not be used except where it is clearly impractical to use some other form of heating device. Where salamanders are used, the coke must not have a sulphur content exceeding 1 per cent.

Ventilation.

General Requirements.—The ventilation and ventilating equipment shall be in accordance with the requirements of the Safety Code for Ventilation.

Removing Smoke, Fumes, etc.—Where the natural circulation of air is not sufficient to remove smoke, gas fumes or dust injurious to the health of employees, mechanical ventilating apparatus of sufficient capacity to do so shall be installed and operated.

Drying Ladles.—Where the operation of drying ladles causes fumes or gases injurious to the health of employees within the foundry, ventilating hoods shall be provided and kept in repair for the purpose of effectively removing such fumes or gases.

Ovens.—All ovens from which fumes or gases injurious to the health of employees escape shall be provided with hoods of sufficient capacity effectively to remove such fumes or gases.

Height of Ceilings.—No foundry in which zinc-bearing metals are melted or poured shall be operated in a room less than 14 ft. in height from the floor to the lowest point of the ceiling, except that where the roof is of peak, saw-tooth or arch construction, the minimum height of the side walls may be 12 ft. If such foundry is installed in the front part of the building, the ceiling shall be in every part not less than 6 ft. 6 in. above the curb level of the street in front of the building, and if such foundry is installed entirely in the rear part of a building or extends from the front of a building to its rear, the ceiling shall be not less than 3 ft. above the curb level of the street in front of the building and the foundry shall open on to a yard or court which shall be not less than 6 in. below the level of the floor.

PART IV.—OPERATING RULES.

Inspection and Maintenance.

Daily Inspection of Equipment.—All ladles, shanks, crucibles, crucible shanks, crucible tongs, yokes, skimmers, slag hoes, crane chains, cables, ropes and slings used in handling or pouring of molten metal shall be inspected daily in regard to their safe condition by the men preparing and using such appliances.

Weekly Inspection of Equipment.—A weekly inspection in regard to the same condition of all crane chains, cables and slings in use for suspending molten metal in mid-air shall be made by a man designated by the employer for that purpose. Written report of such inspection shall be kept.

Defective Equipment.—Equipment found upon inspection to be defective shall not be used while in that condition.

Condition of Tools.—All tools shall be kept properly dressed and free from mushroomed heads.

Riding Chains and Crane Loads.—The practice of riding chains and crane loads shall be forbidden.

Swinging or Dangling Crane Chains.—Swinging or dangling crane chains must clear all obstructions when the crane is in motion, or they must be guided by chainmen walking beneath.

Removing Crucibles from Furnace.—When the combined weight of a crucible containing molten metal and the crucible tongs exceeds 100 lb., the crucible shall be removed from the furnace by not less than 2 men or by mechanical means, and

when the combined weight exceeds 300 lb., 3 or more men or a mechanical device shall be employed.

Use of Explosives and Drop Balls.—The use of high explosives or of a drop ball for breaking scrap shall not be permitted unless done under reasonably safe conditions and under expert supervision.

Locomotives in Foundries.—No locomotive while discharging smoke shall remain inside a foundry during working hours except during such periods as may be necessary for its entrance and exit; but this regulation shall not apply to locomotive cranes nor steam charging machines.

Clothing and Protection Worn by Workmen.

General Requirements.—Head and eye protectors shall conform to the requirements of the National Safety Code for the Protection of the Head and Eyes of Industrial Workers.

Goggles.—When the eyes of employees are liable to injury by dust, flying chips or molten metal, they shall wear suitable safety goggles which shall be provided by the employer.

Helmets and Hoods.—When engaged in sand blasting by hand apparatus workmen shall wear suitable helmets or hoods which shall be furnished by the employer.

Protection for Welders.—When engaged in welding or burning operations by means of an oxy-acetylene or other gas torch, employees shall wear suitable safety goggles which shall be provided by the employer; when engaged in similar operations by means of an electric arc, employees shall use suitable shields or wear suitable helmets which shall be provided by the employer. In both these operations employees shall wear slow combustion aprons or overalls.

Respirators.—When the dust arising from cleaning operations is injurious to the health of the cleaners, they shall wear suitable respirators which shall be provided by the employers.

Shoes and Leggings.—When handling molten metal employees shall wear suitable congress or other approved shoes which shall be furnished by themselves, and, when necessary, shall wear suitable leggings to be provided by the employer.

Qualifications and Duties of Female Workers.

Examination.—No female shall be employed in a foundry unless upon examination by a physician it has been determined that she is of normal size, health and weight for her age.

Effort Allowed.—No female employed in a foundry shall lift any object exceeding 25 lb. in weight unless she uses mechanical means by which her physical effort is limited to 25 lb.

Handling Hot Cores.—No female employed in a foundry shall be permitted to handle cores which have a temperature of more than 110 deg. Fahr. (42 deg. C.).

PART V.—SAFETY AND WELFARE.

Recommendations.

Safety Committees.—Accident prevention should be encouraged by the formation of safety committees among the men. All foremen should take a personal interest in accident prevention and are expected to set an example of carefulness.

Enforcement of Regulations.—Strict enforcement of workshop regulations is one of the best methods of accident prevention.

Educational Methods.—Experience has shown that most accidents can be prevented by supplementing mechanical safeguarding by educational methods; therefore, the use of safety meetings, bulletin boards, motion pictures and suggestion boxes should be encouraged.

Room for Meals.—A room should be provided and kept in sanitary condition for employees' use to eat their meals.

First-Aid Kits.—First-aid kits should contain amongst things not always included in British equipment, 1 wire gauze splint, 2 2-oz. tubes burn ointment, 12-oz. bottle white wine vinegar, 1 2-oz. bottle aromatic spirits of ammonia, 1 2-oz. bottle Jamaica ginger or substitute, 3 paper drinking cups, 12 first-aid record cards, and such other equipment as prescribed by the Industrial Sanitation Code.

[We would suggest that a magnet for extracting metallic chips from eyes should be included.—ED.]

Casting Bronze in Green-Sand Moulds.*

By M. J. LEONARD
(President of the Belgian Foundrymen's Association).

It is obviously advantageous to green-cast bronze castings if the quality of the resulting castings does not suffer. The elimination of drying does away with stoves, saves time, and reduces the importance of box equipment. It not only leads to an improvement in the output of each worker, but also a considerable increase in the possibilities of any one plant. Bronze foundries, if they can solve the question of casting "green," will have, amongst other things, solved the commercial difficulties introduced by the reduction in working hours. Green-sand moulding and machine moulding ought to be the principal items in foundry work. America casts green. This fact is beyond any technical argument.

The author is persuaded that the material is as sound as any of Belgian manufacture. He would add, however, for the sake of completeness, that after personal examination he concluded that their castings were sounder than those which his firm manufactured before the change over.

Recently, at the Birmingham Conference, Belgian foundrymen were able to discuss with certain brassfounders, who assured them that practically their complete production of small castings was cast green. They were limited to 8 lbs. to 10 lbs., and above this weight, drying is general. In the author's foundry all bronze castings are cast green. They are moulded either by hand or on the machine—that is, for weights greater than 4 to 5 kilos., but this is the maximum weight so far accomplished. After more than two years' experience, the author is in a position to say that, for the automobile and machine-tool industries (bearings, connections, tubes and castings up to 3 mm.), green casting is to be recommended from every point of view, including the quality and cost price. Bars of 10 c.m. dia., and 50 c.m. long, moulded upright by squeezing, have been cast green without any difficulty.

Technical Difficulties of the Method.

These technical difficulties divide themselves into two categories.—

(1) *Too Quick Cooling of the Metal.*—Assuming that the mould is filled, this action cannot have any unfavourable results. The author has been quite successful with his castings, especially when teeming as cold as the casting will allow. The structures are closer grained and sounder than ever before. They show a notable increase in hardness and tensile strength.

(2) *Chemical Action by the Water in the Sand.*—Again, assuming that theoretically this can be brought about, then the crust of the metal is rapidly formed by contact with the mould. From this it guarantees the inside. This point is only raised in order that an answer to the previous question can be given.

Bronzes Used.

They are of a phosphoric type, containing 12 to 14 per cent. tin, and are de-oxidised by phosphor copper. Sometimes they are of a machinable type, containing 6 per cent. tin and 4 per cent. zinc. The author has had no experience of casting brass.

Sands.

It is necessary that the sand must be porous, and not too strong, in order that, with the moderately-hard ramming necessary to obtain good castings, this ramming may not have any bad influence on the porosity.

The author's firm has a monthly production of 1 to 5 tons of bronze. The majority of bronzes cast should be green cast. Brass, it should be understood, is not being considered. The author is aware, however, that recently some foundrymen are teeming brass into green-sand moulds. These foundrymen affirm that casting green has enabled them to cast successfully very difficult brass castings which previously could only be done by stoving. In this particular case the green-sand casting had the advantage of allowing the casting to contract during solidification much better.

* Translated from the Bulletin of L'Association Technique de Fonderie de Liege.

The "Henri-Paul" Foundry of Messrs. Schneider et Cie.*

The Organisation and Equipment of a Modern Foundry for the Production of Heavy Castings.

The founder's art may be considered as one of the oldest branches of metallurgy. During several centuries it was abandoned to narrow, rule of thumb methods, and until quite recently did not benefit in any degree from the scientific methods of work and organisation that have led to such rapid progress in the mechanical industries.

It should be remarked, however, that the diversity and power of foundry equipment do not, necessarily, form the principal factor in output. More often than not, hand work, and the methods and ideas which direct it, is responsible for the success or failure of large castings. The experience of the moulder, his skill and loyalty; the trustworthiness of the foreman, all play an important part.

It would seem, then, that a foundry is more of a mechanical than a metallurgical industry, and that it would lend itself more particularly to organisation on mechanical principles.

Before describing the plant and working methods of a large, modern foundry, it will be as well to consider briefly the progress attained in the metallurgy of iron.

Historical.

The history of iron is closely connected with that of civilisation, and it is a very debatable point whether the opinion that copper preceded iron is correct. The Egyptians used iron from the Fourth dynasty of the Pharaohs, 3,500 years B.C., and it was known to the Phœnicians more than 2,500 years before our era. Whether or no iron was preceded by bronze, or, more correctly, brass, it is certain that castings were first made in the latter metal; owing, no doubt, to its greater fusibility and the simple equipment necessary for its working. Still, it can be admitted that iron was known at least 4,000 years before copper alloys were cast. Cast iron, however, was not known until the middle of 14th century. The discovery was made in a Sussex works between 1335 and 1355, and in the same district were cast, in 1543, the first iron cannon, some of which weighed three tons.

During the succeeding centuries the metallurgy of iron made but slow progress, and it was not until the 18th century that the discovery of coke made the blast furnace possible, and greatly extended the use of cast iron.

About 1760 there were in England 106 blast furnaces, of which 81 were coke and 25 wood fired, giving, respectively, an output of 17 and 10 tons of iron per week.

In 1870 William Wilkinson, the English inventor of the cupola, was invited to Creusot to install his plant. About 1800 Messrs. Schneider et Cie took over the Creusot works, which have since been the leading French ironworks. A constantly increasing demand made further extensions necessary in 1853, and it was at this time that floor moulding was introduced into France. Up till then this method was practised exclusively in England, which had consequently the monopoly in making heavy castings. Messrs. Schneider have recently completed their new foundry, "Henri-Paul," at Montchanin-les-Mines.

"Henri-Paul" Works.

The "Henri-Paul" works, comprising iron foundry, brass foundry, pattern shops and other departments, had to be erected at Montchanin-les-Mines because there was not sufficient space at the Creusot site.

The new foundries were planned on a very large scale, and when working at full capacity are estimated to be capable of an output of 40,000 tons of miscellaneous castings per year. Almost the whole of the output is dealt with by the machine shops and other departments of the Schneider organisation. The brass foundry has a capacity up to 3,000 tons, and the pattern shop can satisfy the demands of both foundries.

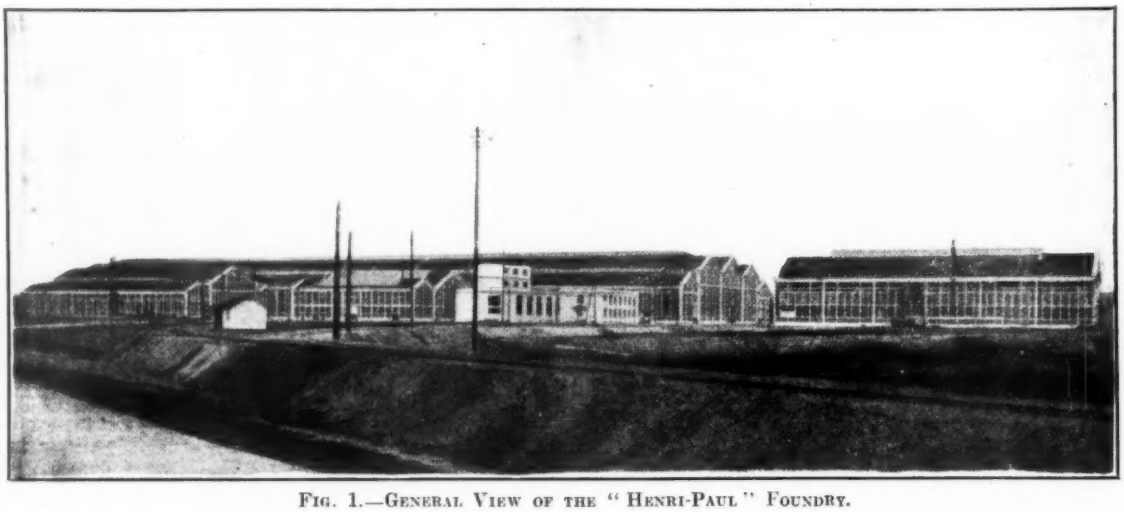


FIG. 1.—GENERAL VIEW OF THE "HENRI-PAUL" FOUNDRY.

In view of the importance of the buildings to be erected, it was necessary to conceive a comprehensive scheme that would adequately meet all future requirements. The demands of the present were carefully considered in the light of past experience, and, so far as was humanly possible, the whole scheme approached the ideal lay-out.

Construction was commenced in June, 1918. Meanwhile a commission was sent to the United States to study the latest methods of working and also the technical side of modern foundry practice. The first cast was made on June 19, 1920. A general view of the works is shown in Fig. 1.

The following description gives the principal features of a modern foundry, and the methods employed at the Henri-Paul works.

As a rule foundries are deficient in storage-room and open spaces, which leads to inefficient distribution of raw materials, and especially of moulding boxes, which are generally piled on top of one another. On the other hand, in order to avoid unnecessary handling, it is important to have boxes and frames of the same type in piles.

* Translated from an article entitled "Une Fonderie Moderne," which appeared in *Science et Industrie*.

For the sake of efficiency it is necessary for raw materials, coke, ore, sand, etc., to enter the shops at one end, whilst finished castings leave at the other. In other words there must be a steady flow of material through the works in one direction only. This requirement is met by the general lay-out shown in Fig. 4.

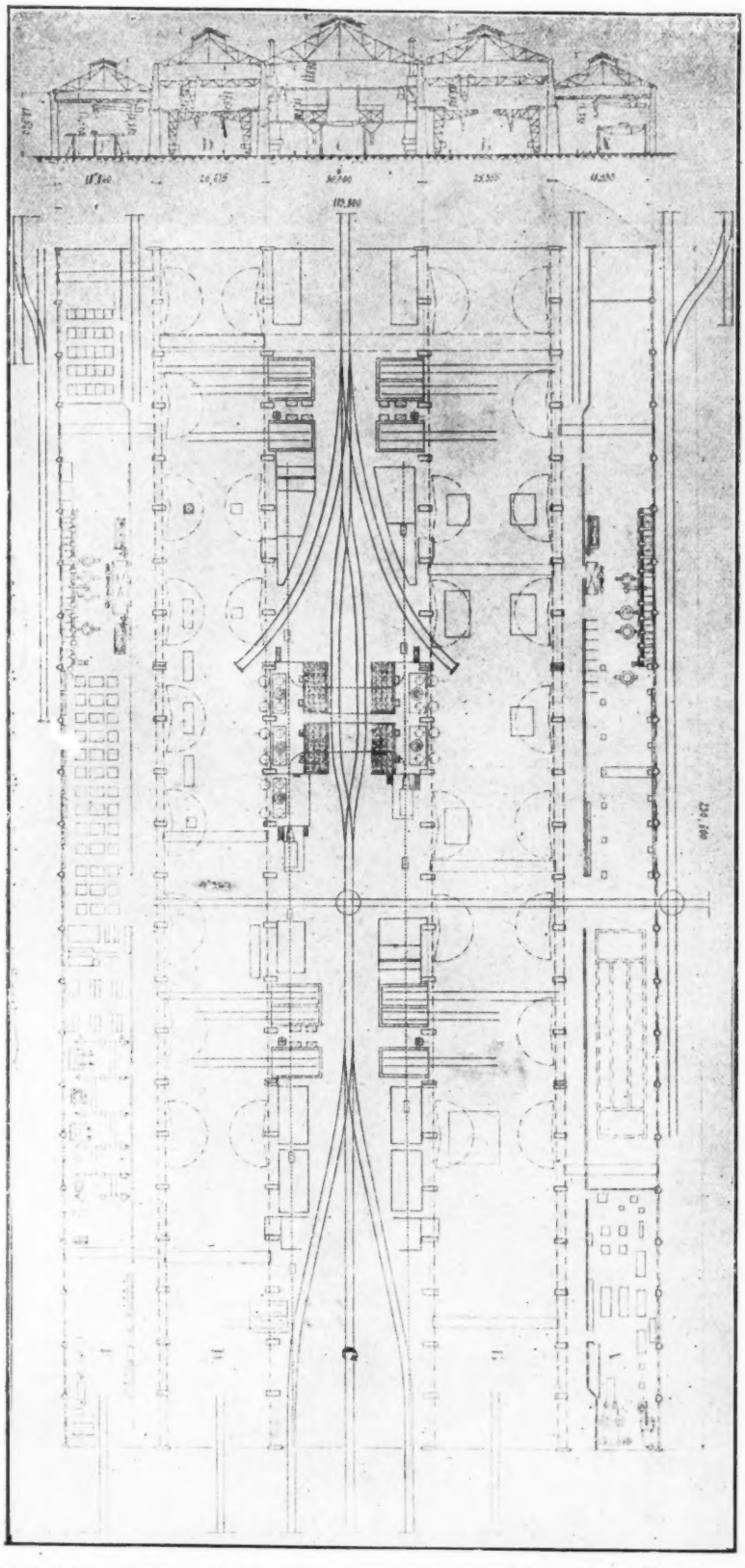


FIG. 2.—PLAN OF IRON FOUNDRY.

A=Pattern Stores, Sand Mixing, Apprentices Stores, Raw Material Bins. B=Heavy Castings and Dressing Shop. C=Gas Producers, Stoves, Cupolas, Coke Workshop, Open Sand Moulding, and Repair Shop. D=Medium Castings, Filling Shops, and Sand Blast. E=Pattern Stores, Sand Mixing Core Shop, Machine Moulding and Filling.

Situation.

The site, nearly 60 acres in extent, is on the Central Canal not far from the port of Bois-Bretoux, with which it will be connected by water in the future; it is served by the Paris-Lyon railway, and a private railway connects it with the Creusot works and the port of Bois-Bretoux. The raw materials arrive at Y, and, without the use of a turntable, can be distributed either to the stock-yards or to the bins in the foundries. Fnished products leave at Z (Fig. 4), which connects directly with the main line.

All the portable equipment, box parts, frames,

chills, etc., are arranged in the yard I, which is served by two overhead electric cranes of 3 tons and 5 tons, and a 15-ton steam crane. The supplementary stock-yard J is served by a 15-ton locomotive steam crane. All the pig-iron, runners, etc., are handled by electro-magnets. Shunting and haulage in the works is done by a small, steam locomotive, and also by a Schneider petrol-locomotive. Two tracks, running the length of the iron foundry allow trucks of moulding sand to be brought within reach of the overhead cranes. The material is then distributed, by means of special skips, to hoppers situated in different parts of the building.

The general arrangement of the iron foundry is shown in plan, Fig. 2. Briefly the arrangement is as follows:—

Bay A.—(1) Pattern stores. (2) Sand and loam mixing shop. (3) Timber stock-yard. (4) Open sand moulding shop. (5) Repair shop.

Bay B.—(1) Heavy moulding shop, loam and dry sand. (2) Dressing shop.

Bay C.—(1) Stores and gas producers. (2) Cupolas. (3) Coke store. (4) Bins for raw material.

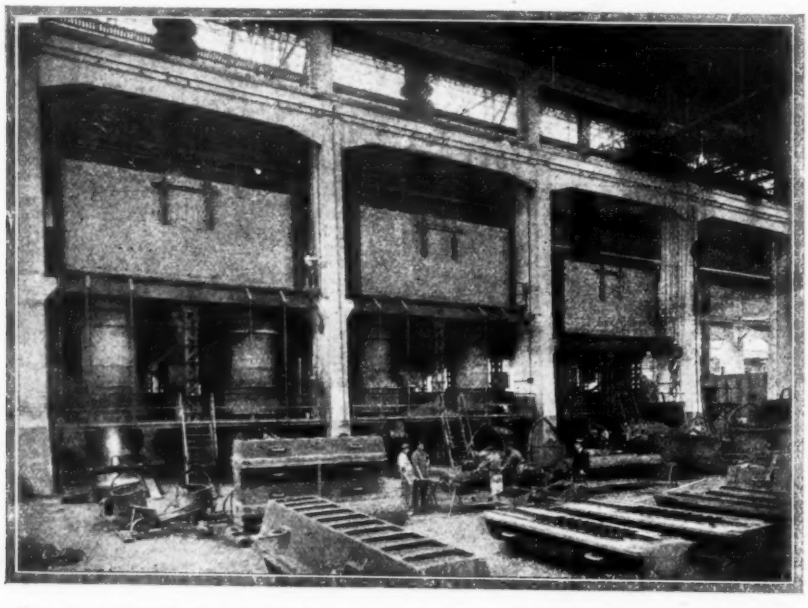


FIG. 3.—A GROUP OF SIX CUPOLAS OF 8-TON AND 4-TONS PER HOUR CAPACITY. THEY ARE SITUATED IN BAY D.

Bay D.—(1) Medium moulding shop. (2) Dressing shop.

Bay E.—(1) Pattern stores. (2) Sand mixing. (3) Core shop. (4) Machine moulding. (5) Dressing shop.

Melting Plant.

The melting plant employed in the majority of foundries is the cupola, the many varieties of which are all based on a standard type. Although

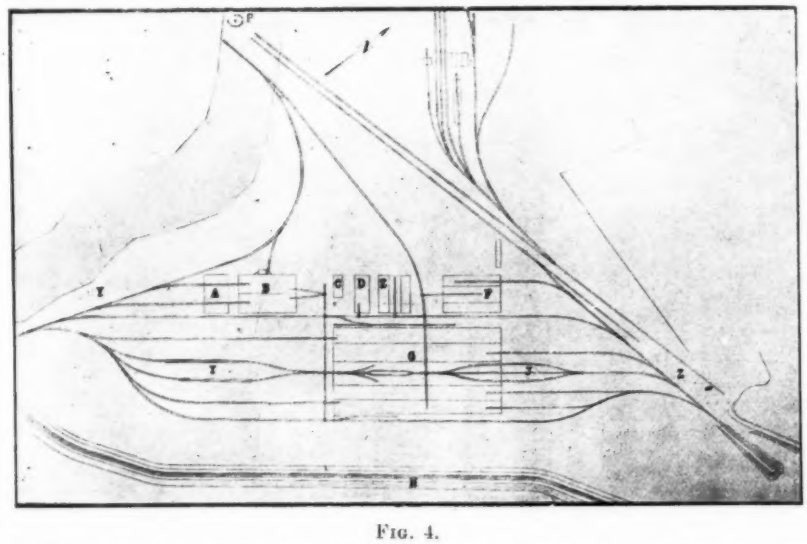


FIG. 4.

A=Timber Stores. B=Pattern Shop. C=General Offices and Sub-Station. E=Stores, Lavatories, Baths, etc. F=Brass Foundry. G=Iron Foundry. H=Canal. I =Raw Material and Moulding Box Stock Yard. J=Supplementary Stock Yard.

The building is of reinforced concrete, with steel framework, roof principals, etc. There are five main bays, A, B, C, D, E, of which the centre bay C lies between the heavy casting shops A B and the bays D and E, which deal with medium and light work.

Each bay comprises, from left to right, the following plant:—

the cupola has been used for more than a century it is only during the last few years that a scientific study has been made of its technique. Under the direction of competent metallurgists the cupola provides first-class metal, and allows a wider variation in product, together with more economical working than is possible with reverberatory furnaces. There are 10 cupolas in the

Henri-Paul works; 4 of 12 tons in Bay B (heavy castings), 4 of 8 tons per hour, and 2 of 4 tons in Bay D (medium castings); these are shown in Fig. 3. The cupolas are of modern design, slightly narrowed at the base, mounted on columns and with drop bottom. Two rows of tuyeres, with a section approaching one quarter of that of the cupola, are taken from the annular air belt. The blast for each group of cupolas is supplied from one station comprising one Sturtevant blowers driven by direct-coupled motors and feeding into a common blast-box, from which each cupola can be shut off by a valve.

The normal blast pressure is about 20 in. of water, and the volume approaches 35,000 cub. ft. per ton per hour.

Blast control, both volume and pressure, for each cupola, is obtained by means of a special apparatus, combining a Pitot tube and an ordinary anemometer mounted on a wood board. As shown in Fig. 3 the cupolas are surmounted by a dust-chamber, common to two cupolas, and provided with a single stack. A baffle plate prevents the circulation of the dust which consequently falls into a lower hopper, from which it is practically removed. The charging platforms for each group

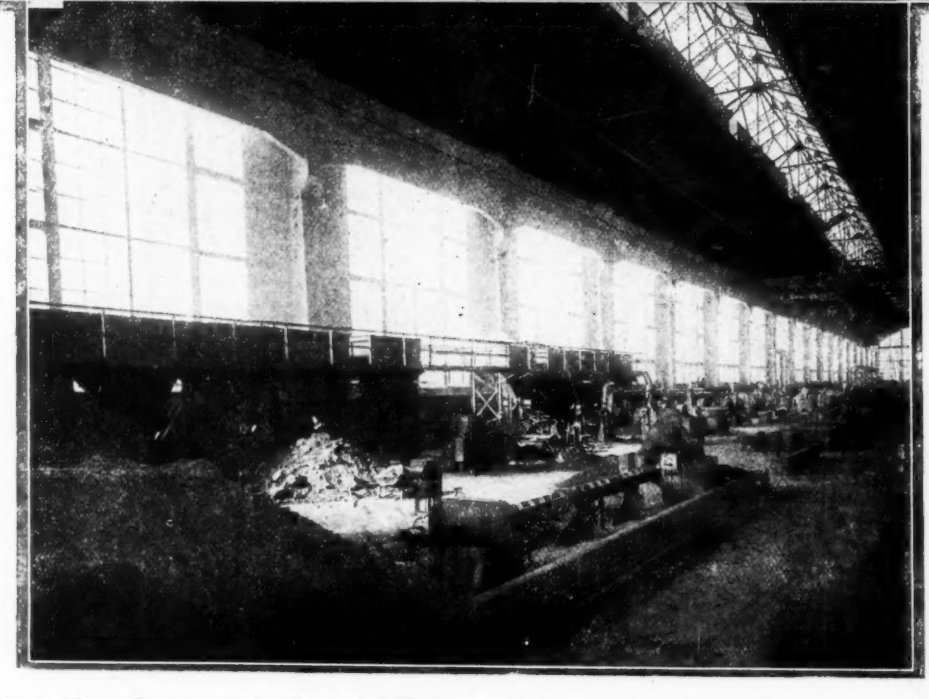


FIG. 5 (UPPER ILLUSTRATION).—SHOWS THE METHOD OF CHARGING THE CUPOLAS BY DROP-BOTTOM SKIPS.
FIG. 6 (LOWER).—GENERAL VIEW OF THE SAND-PREPARING PLANT SITUATED IN BAY A.

are connected by gangways, and each posseses two coke bins, with a capacity of 65 tons. The bottoms of the coke bins are provided with gratings which allow the fine coke and dirt to fall into a hopper. On each platform are bins containing a week's supply of limestone and other fluxes.

The charging of the cupolas is semi-mechanical. Coke and limestone are charged by hand, whilst the pig-iron is tipped into inclined hoppers, run up to the charging doors as shown in Fig. 5. The skips conveying the pig, etc., have drop bottoms, and are carried on an electrically-operated overhead, mono-rail runway. The charging boxes, or skips, are replenished from the iron bins in the central bay, and the charges are weighed on either a weighbridge or, in some cases, a steel-yard. The cupolas are lighted by oil burners—using heavy oils—which considerably reduces the time for lighting, and eliminates the handling of wood and coal.

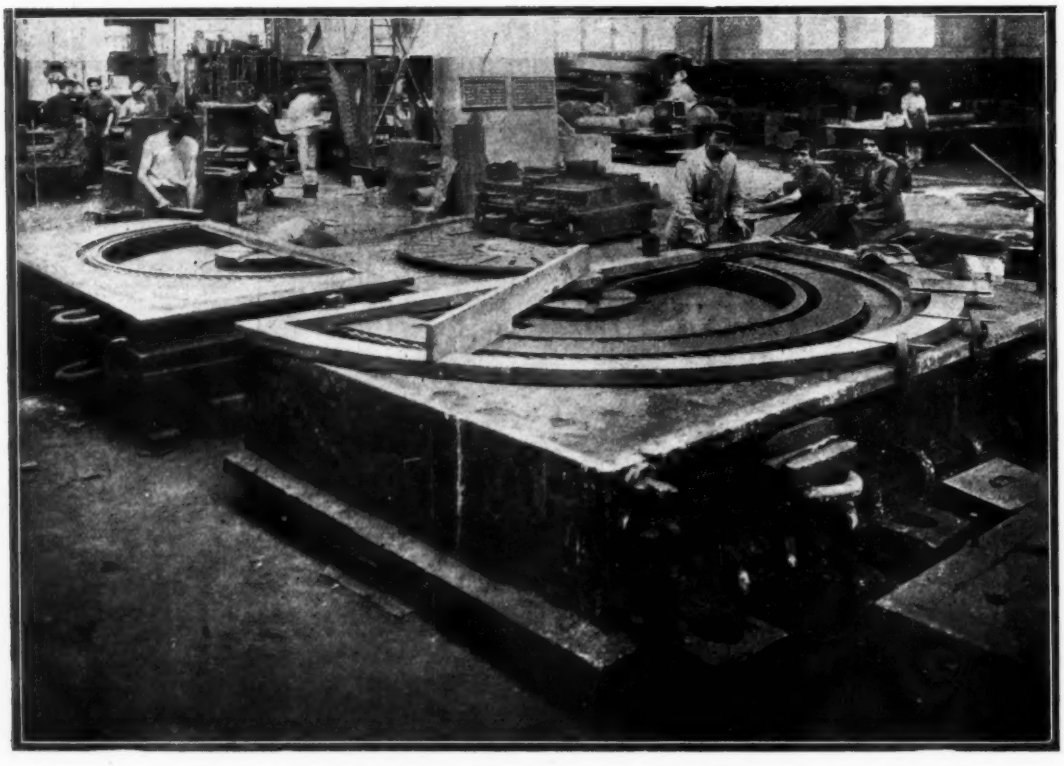


FIG. 7.—A DRY-SAND MOULDING JOB IN PROGRESS.

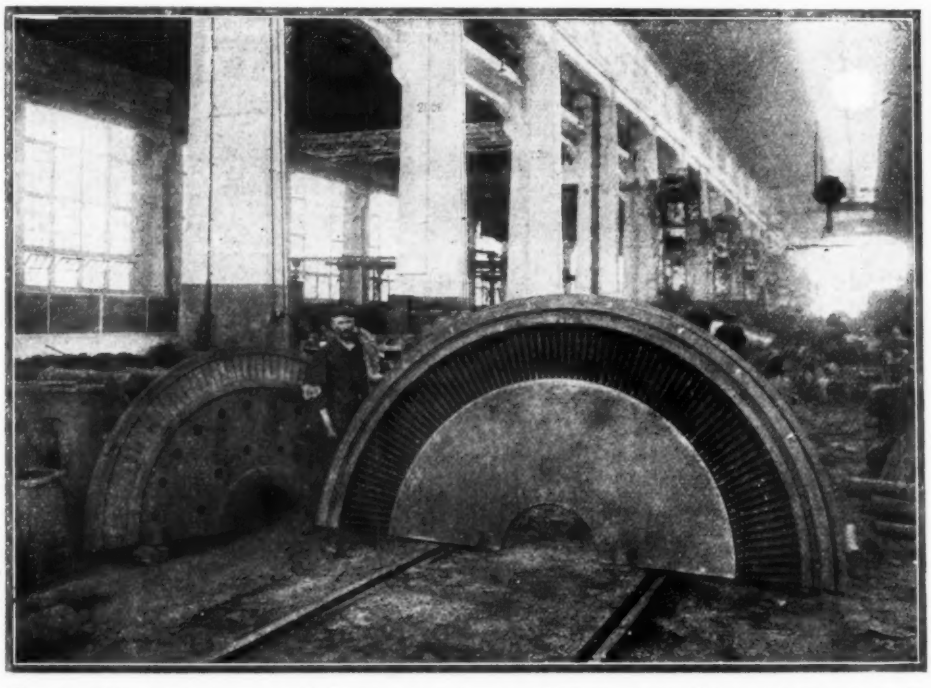


FIG. 8.—GUIDE RING FOR A 40,000-KILOWATT TURBINE MADE FROM THE MOULD SHOWN IN FIG 7.

Sand and Loam Mixing.

Although sand mixing is a very simple matter there has been a good deal of controversy as to whether or no it should be performed by mech-

anical means. The great quantities of sand employed, and the variable condition, as to moisture, in which it is required have led to this disagreement. As might be expected, the German method tends to over-elaboration, and its employment of automatic dryers, mixers and humidifiers represents the extreme mechanical system. The exclusive use of shovel and barrow represents the other extreme. The best method probably lies between these two extremes. It is evident that any machine for handling sand must be of simple and robust construction, because of the abrasive action of sand which would be particularly destructive to a complicated machine.

At the Henri-Paul foundries sand mixing is carried out in Bay A, see Fig. 6, and comprises both mechanical and hand devices. The sand and loam are deposited by special skips into sheet iron hoppers, from which they are fed to pan mills by means of a belt conveyor.

From the pan mills the sand is shovelled by hand into rotary screens. From the screens the sand is distributed to the moulding shops in special skips that can be carried on electric trucks, runways, or on travelling platforms, or, again, by the overhead cranes. On leaving the screens some of the sand is selected for further division, which sensibly increases its cohesion. After this process it is fed by screw conveyor into drop bottom skips for distribution in the foundries. There are eight pan mills, three of which are for dealing with special moulding loams.

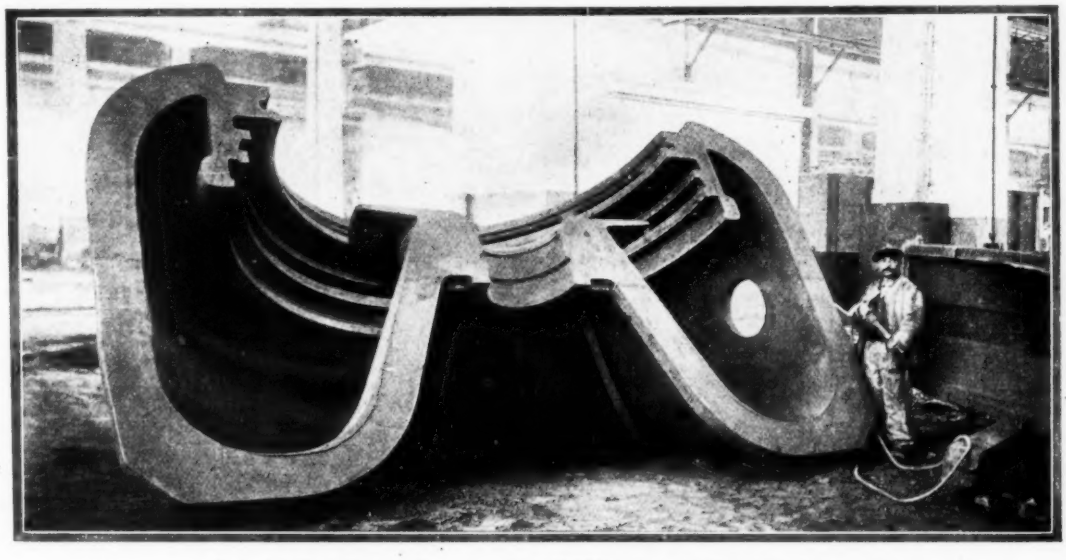


FIG. 9.—THE UPPER HALF OF THE 40,000-KILOWATT TURBINE CASING.

Transport Arrangements.

It has been estimated that the weight of material handled in a foundry in a given time is 80 times that of the castings produced. This means that for efficient working ample provision must be made in the way of lifting tackle. Not only must there be cranes but smaller lifting tackle must be provided for the moulders for placing cores in position and removing patterns. Since some of these operations take a considerable time, it is necessary to provide each group of moulders with their own tackle, so that there may be no dispute. This idea has been carried out in the Henri-Paul foundries as follows:—

In the heavy moulding shop 15 fixed electric cranes are provided, each of 20 tons capacity. In the medium moulding shop there are 14 10-ton cranes of a similar type. These cranes, with certain exceptions, are operated by the moulders themselves. In addition, the building is served by the following plant: Bay A, two 5-ton jib cranes; Bay B, one overhead crane 30 tons, one of 60 tons, and one of 120 tons; Bay C, eight overhead runways, 1½ tons; Bay D, three overhead travelling cranes of 30 tons; Bay E, two 5-ton jib cranes and one 3-ton overhead crane. All these are high-speed cranes electrically driven. In the two bays there are 17 casting pits in reinforced concrete, all of which are within the radius of the fixed and overhead cranes. The smallest of the casting pits is 6 ft. wide and the largest 33 ft. Their depth varies from 10 ft. to 22 ft., and all are made absolutely waterproof.

Stoves.

Thorough drying of the moulds is, of course, an absolute necessity in a foundry, especially in cases where there is a great deal of water to be driven off. The best temperature is about 350 deg C.

Although differing in detail, there are three principal types of stove in use in France. They are (*a*) coke fired, (*b*) fired by coke dust, (*c*) gas fired. In America a fourth type is used fired by heavy oils. Gas-fired stoves of the most modern design have been installed at Henri-Paul. They have the advantage of close and simple regulation and leave no deposit of dust on the moulds. The stoves are arranged in two batteries of six stoves, each battery being fed from a group of three Siemens gas producers. Each battery of six stoves is arranged in two similar groups of three, having a capacity of 5,000, 7,000, and 9,500 cub. ft. respectively. Each stove is furnished with an electric pyrometer with thermo-couples of nickel-constantan.

Assembled moulds of great size which would enter the stoves with difficulty, or which might be damaged if moved, are dried in place by portable dryers which circulate hot air through the closed moulds. These dryers are coke fired and quite self-contained, each one carrying its own motor and fan. One or more of these portable dryers can be employed on each mould according to its size.

Principal Types of Castings.

Limits of space make it impossible to give more than a general outline of the types of castings turned out by this foundry. If the material of which the mould is made is considered only there are no more than four methods employed. They are green-sand moulding, dry sand, loam, and chill moulds. In confining attention to the question of material it must be remarked that moulding sand consists of an aggregate of grains of silica coated with clay, the latter representing 15 to 20 per cent. of the total volume. The silica makes the material sufficiently refractory to withstand the heat of the molten metal, and the natural porosity allows the escape of gas. This escape of gas and steam, due principally to the moisture in the sand, must be efficiently vented in the case of green sand or it will lead to serious trouble, especially in large castings. The moulds for heavy and important castings are consequently dried in the stove at fixed tem-

peratures and times according to size. Apart from the drying the stoving hardens the mould as a whole and makes it better able to withstand the pressure of the molten metal during pouring. Figs. 7 and 8 show respectively the dry sand, or stoved, mould and the resulting casting—the guide ring for a 40,000-kw. turbo-generator.

sure of the molten metal. To obtain sufficient porosity straw and manure are mixed with the loam in the pan mills. When the mould is stoved or dried these materials burn away, leaving vents for the passage of gas during teeming.

Fig. 10 shows a loam mould in the early stages. The bricks and loam are being built up

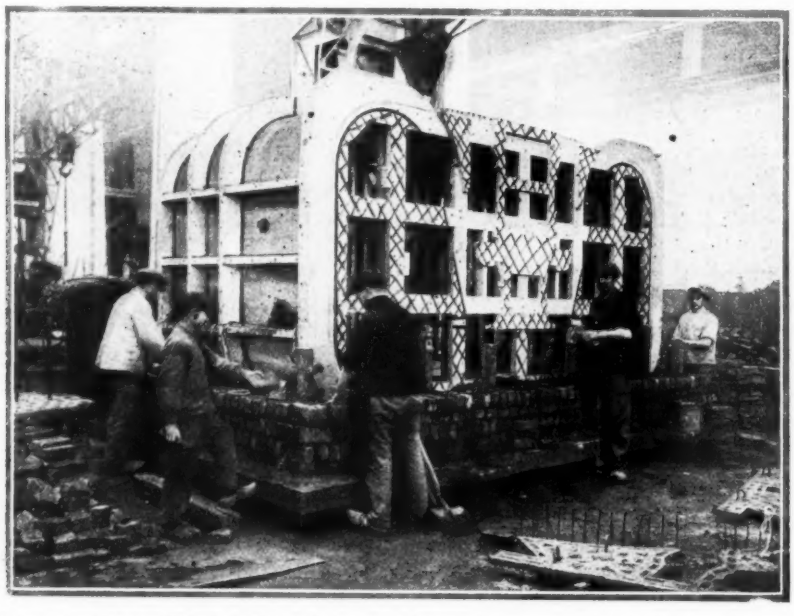


FIG. 10.—EARLY WORK ON LOAM MOULD. NOTE THE BRICKS AND LOAM BEING BUILT ROUND THE PATTERN.

Loam moulding is undoubtedly the most difficult phase of the moulders' art. In this case the moulding sand contains a much higher proportion of clay, about 30 per cent., and a high content of water to bring it to the plastic state after passing through the pan mill. This method of moulding is used almost exclusively for large and heavy castings, of which perhaps only

around the pattern. Considering the number of castings to be made the pattern is very much lighter than it would be for a green- or dry-sand mould. The mould is that for the lower half, exhaust end, of a 50,000-h.p. turbine casing, the resulting casting being shown in Fig. 11. Fig. 9 shows the upper half of the same casing, which was moulded in loam. Fig. 12 shows the two

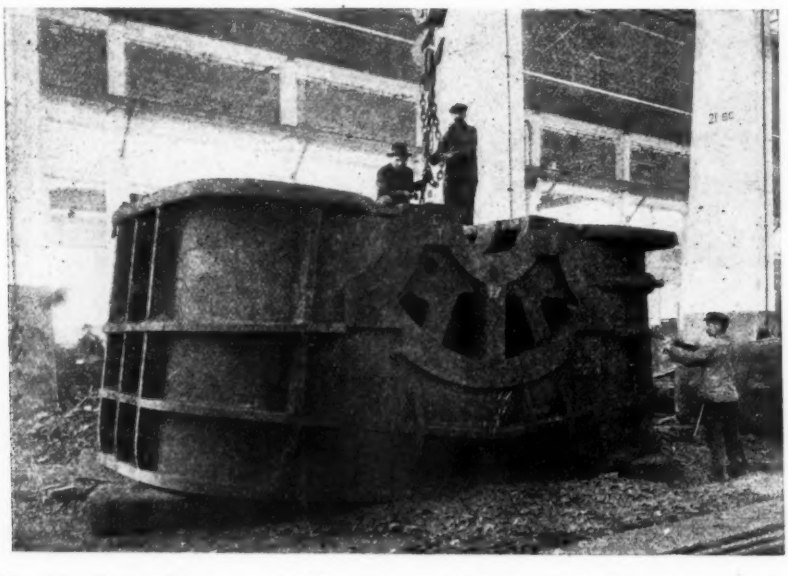


FIG. 11.—LOWER HALF OF A 40,000-KILOWATT TURBINE. THE BEGINNING OF THE MOULDING FOR THIS JOB IS SHOWN IN FIG. 10.

one is required. With this method the cost of the pattern is greatly reduced, since it may be very lightly constructed or even only a skeleton. The mould is composed of bricks and loam which is used like mortar. Spaces filled with cinders are left between the bricks to facilitate the escape of gas. Plates and tie-rods are built into the brickwork in order to stiffen and strengthen the mould to withstand the heavy internal pres-

halves assembled in the machine shop. In spite of the advantages of loam moulding it is gradually being displaced in modern practice. The moulding time is longer, with consequently greater expense, and the successive handling due to repeated and prolonged dryings is leading to the employment of the dry-sand method instead of loam moulding. The use of sand for moulds for very heavy castings as suggested in the latest

ideas might appear somewhat risky, but it will enable large pieces to be turned out in a much more economical manner, particularly as regards the making and placing of cores. In addition to the advantages enumerated above, sand moulding allows a clearer division of operations and work, leading to a more accurate estimation of time and consequently better costing.

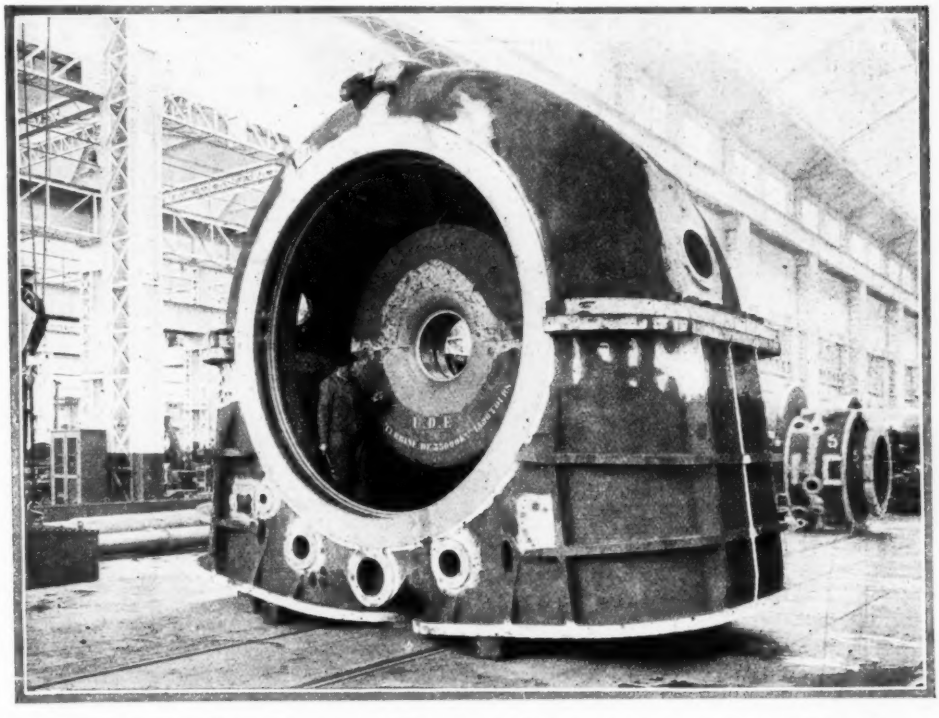


FIG. 12.—THE TWO HALF CASES OF 40,000-KILOWATT TURBINE CASING ASSEMBLED. OTHER VIEWS OF THIS JOB ARE SHOWN AN FIGS. 9-11.

Chill Castings.

Casting in metal moulds, or "chills," is chiefly employed for the making of small pieces requiring a hard skin. The only large castings made by this method are the rolls for rolling mills engaged on thin plates. The sudden cooling due to the metallic mould produces a very hard skin that may attain a depth of about 1 in.

Cores.

The preceding outline of the organisation of a modern foundry shows that the tendency is to split up the work. This necessitates special attention to the lay-out and equipment of the core shop—one of the most important departments in a foundry. Basically the core shop must, at all times, be able to meet the demands of the moulders.

FIG. 13.—THE N.E. EXTREMITY OF THE CORE SHOP SITUATED IN BAY E.

In the "Henri-Paul" foundries every care was taken to make this a model department. Fig. 13 gives a view of one end of the core shop. Large metal plates, with machined surfaces, resting on low trestles form tables on which the cores are finished and examined after being removed from the boxes. From the table the cores are lifted straight into the stoves by small swinging jib cranes.

Moulding Machines.

Moulding machines have long since been introduced into foundries for the production of small parts, and many excellent types of hydraulic machines are made in France. Since their technique is specialised it is unnecessary to give more than an outline of this department. Nevertheless, a few notes may be given about the moulding machines operated by compressed air in which ramming is accomplished by jar ramming. These machines can deal with castings up to 10 ft. × 5 ft., and their use will soon be extended to accommodate much larger patterns. These machines mark the greatest advance in foundry practice during the last twenty years. Of American origin, the idea was to supplant hand ramming, sometimes irregular and always slow, by mechanical ramming which would be consistent and accomplished at a pace far greater than that of the most skilful moulder. In addition to automatic ramming, some of the machines are provided with mechanical means for withdrawing the pattern when the mould is reversed. There are eight machines of this type at the Henri-Paul Works, the most powerful having a table 6 ft. 6 in. square and capable of carrying a weight of 6 tons. Each machine is served by a 2-ton, hand-operated electric crane; greater weights are dealt with by one of the main overhead electric cranes.

Cleaning.

Dressing and cleaning of the castings is carried out almost exclusively by mechanical means. Pneumatic tools and sand-blast plant of modern designs are employed. Fig. 14 shows one part of the dressing shop and sand-blast chamber.

A well-equipped repair shop is provided, capable of dealing with all plant repairs and renewals. All moulding tools, too, are kept up to full efficiency by this department.

Compressed Air.

An abundance of compressed air is distributed throughout the works. There are two compressors of 700 cub. ft. capacity working at a pressure of about 90 lb. per sq. in. A stand pipe with two or four cocks is fixed at each stanchion supplying air for rammers, pneumatic tools, or sieves as required. Moulding machines and sand-blast chambers are supplied from a special circuit.

Lighting.

The question of lighting has been carefully considered; during the day light is freely admitted as something like 80 per cent. of the walls and ends of the buildings are glazed. Ample provision of artificial light has been made in order to avoid accidents. A total of 309,200 candle power is provided for the buildings, of which 246,000 candle power is located in the iron foundry, not including the lighting of the yards. This generous illumination of 10 candle power per sq. yard is supplemented by portable lamps with flexible cables for special work on large moulds.

The welfare department, too, has received attention, for there are three dressing-rooms with a total of 1,324 separate lockers each complete with shelves and coat-hooks. Three bathrooms for men, women, and apprentices; lavatories of modern design built with glazed bricks, and an infirmary equipped for first aid are included. All these special arrangements, coupled with efficient ventilating and lighting of the shops, enable employees to work under the best possible conditions.

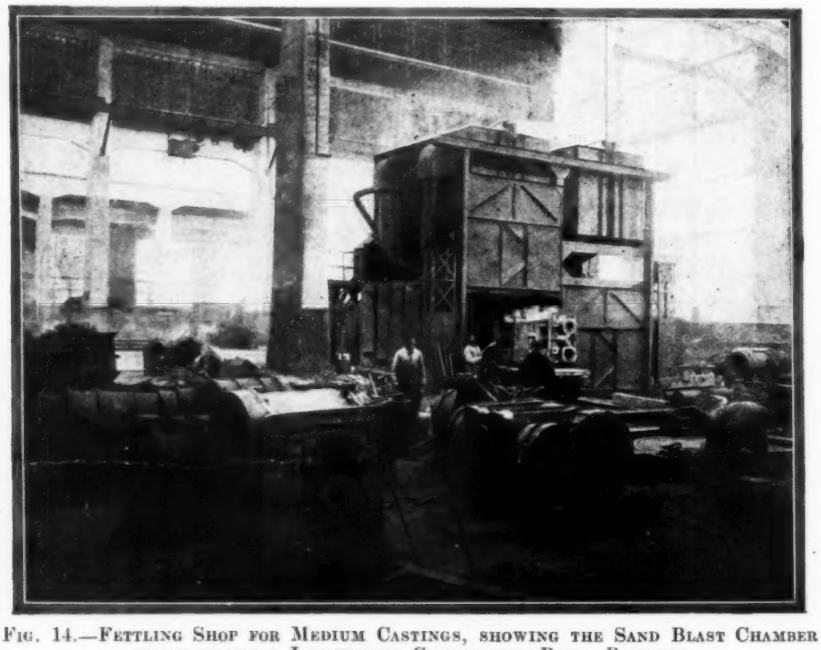


FIG. 14.—FETTLING SHOP FOR MEDIUM CASTINGS, SHOWING THE SAND BLAST CHAMBER FROM WHICH A LOCOMOTIVE CYLINDER IS BEING REMOVED.

Organisation.

The work of a foundry is exceedingly complicated, and each day presents fresh problems for solution. It is only during recent years that modern methods of organisation have been applied to foundry practice. In these works the organisation embodies an executive staff and an office staff for dealing with routine work. In close touch with both of these staffs is the department making time and method studies of the work. Each operation is exhaustively examined and accurate times are taken for standard work. The importance of these time studies may be realised when it is considered that between 3,000 and 4,000 man-hours may be expended on one mould. The results of the studies are carefully collated and give valuable data which are far more reliable than the usual rule-of-thumb estimating. The data obtained are constantly revised, and the whole organisation leads to systematic increase of output and reduction of cost. This careful examination of each job also enables the executive staff to appoint

workmen to the tasks for which they are best fitted. This method of selection soon sorts out skilled men and prevents their employment on work that only requires unskilled labour.

Those responsible for the management of the Henri-Paul foundries do not believe their plans have reached finality, but are constantly on the alert and are ready at all times to try out new ideas.

Obviously such a foundry has only been built up by the close co-operation of many of Messrs. Schneider's staff, whose ideas were co-ordinated under the direction of Mons Barret, one of the works managers at Le Creusot.

Contracts Open.

Chesterfield.—Supply of about 2,600 yards of 48-in. socket and spigot pipes in 12-ft. lengths and specials, for the Corporation of Chesterfield. Mr. Vincent Smith, borough engineer and surveyor, Chesterfield.

Hitchin, January 26.—Provision and laying of about 2,740 yards of 3-in., 210 yards of 2-in. cast-iron water main, and 1¼-in. and ¾-in. galvanised water pipe, for the Council. Mr. W. Phillips, Gasworks, Luton. (Fee, £2 2s., returnable.)

London, N., January 31.—Stores, for the Islington Borough Council. Mr. C. G. E. Fletcher, town clerk, Town Hall, Upper Street, N.1.

Manchester, January 22.—Supply of ventilating grids and other castings, for the Public Health Committee, Mr. J. Irvine, manager of the drainage branch, Public Health Department, Civic Buildings, 1, Mount Street, Manchester.

San Francisco, California.—Supply of 12, 14, and 16 in. cast-iron water pipes. The Department of Overseas Trade, 35, Old Queen Street, London, S.W.1.

Publications Received.

Messrs. John Brown and Company, Limited, Atlas Steel and Ironworks, Sheffield.—"Tool and Alloys Steels" is the title of a very handsome brochure just issued by this world-renowned concern. Our American cousins would probably emphasise the word "service" in connection with such a booklet, as unconsciously it must make the tool steel user feel that in this firm he has at his beck and call, not only a wealth of practical experience, but a technical organisation capable of solving his most difficult problems. There is only one adverse criticism we have to make, and that is that the Fahrenheit scale is used throughout. We feel sure that, with the possible exception of the U.S.A., any person entrusted with the heat treatment of steel visualises temperatures in the centigrade scale. The Air Board Specifications are outlined, as also are Brinell numbers, and various useful conversion tables. We would advise all foundrymen to secure a copy whilst they are available, they will find the notes on using high-speed steel especially helpful.

Messrs. William Jacks and Company, Winchester House, Old Broad Street, London, E.C.2.—"The Iron and Steel Trades in 1922." This 20-page booklet should certainly be carefully studied by British foundrymen. It is not exactly cheerful, but one can at least be sufficiently optimistic to console oneself that next year's publication cannot be any worse, and is likely to be better.

MR. FRANK GILL, president of the Institution of Electrical Engineers, was the speaker at a recent meeting of the North-Eastern Centre, held at Armstrong College, Newcastle, under the chairmanship of Mr. F. G. C. Baldwin, president of the local Centre. In the course of an interesting address, Mr. Gill expressed the emphatic opinion that engineering was largely concerned with economics—although, somehow, the engineer rarely knew anything about that subject, and so was ignorant of the application of engineering with the least possible cost, the elimination of waste, and the reduction of expenditure. One reason why economics was not taught was because much of the teaching was on apparatus engineering, but if the engineer wanted to remain in business he must be keen on doing as well for the customer as for himself. In other words, the engineering of a job largely depended on its cost, so the teaching of systems engineering was a very important thing.

Trade Talk.

FERRER HAWKINS & COMPANY have removed from 2, Thames House, Queen Street Place, London, E.C.4, to 150-151, Fenchurch Street, London, E.C.3.

C. P. DREVER & SON (KETTERING), LIMITED, engineers and contractors, have removed their London office from 7, Maddox Street, to 141, New Bond Street, London, W.1.

LICENCES under the Non-Ferrous Metal Industry Act, 1918, have been granted to Baerlein & Sons, Limited, Manchester, and Fuerst Brothers & Company, Limited, London.

R. AND W. HAWTHORN, LESLIE & COMPANY, LIMITED, Newcastle, have received an order from the East Indian Railway Company for 15 large superheated goods locomotives.

THE MOTHERWELL IRON AND STEEL COMPANY, LIMITED, have decided upon a reorganisation of capital, the arrangements for which are in the hands of Mr. Alex. Moore Shaw, of Glasgow.

MELDRUMS, LIMITED, Engineering Works, Timperley, near Manchester, received 17 orders during December for forced draught furnaces and mechanical stokers, and also orders for six refuse destructors.

AFTER a long period of inactivity, the rail mill at the United Steel Companies' Moss Bay Works, at Workington, resumed operations last week. As far as can be seen the rail mill will run for about three weeks.

PARMITER, HOPE AND SUGDEN, LIMITED, manufacturing electrical engineers, have removed their offices and works from 50, Ellesmere Street, Hulme, to the Fluvent Electrical Works, Vernon Street, Longsight, Manchester.

IT IS REPORTED that Baldwins, Limited, are contemplating an early resumption of work at their Brymbo Steel Works, and that the Broughton Solvay Coke Ovens, belonging to the Brymbo Steel Company, Limited, are already being relighted.

IN AN ADDRESS to members of the Birmingham section of the Institute of Metals, Dr. F. Johnson (head of the Metallurgical Department of the Municipal Technical School, Birmingham) dealt with the subject of the mechanical treatment of metals.

MR. T. G. BACON, formerly with English Electric and Siemens Supplies, Limited, has established himself in business as an electrical engineer and factor under the style of Lighting, Heating & Traction Supplies Company, at 43, Doughty Street, London, W.C.1.

THE COVENTRY BRANCH of Hotchkiss et Cie, who since the cessation of hostilities have been engaged in the manufacture of engines and chassis for the Morris cars, have been acquired by the Morris Company. The style under which the new company will carry on business is Morris-Hotchkiss Engines, Limited.

AMONG the new companies which are about to be floated is the Great Eastern Train Ferries, Limited. This company was formed with a capital of £400,000 in £1 ordinary shares, for the main purpose of establishing a train boat ferry system which will permit of direct through traffic between Harwich and Zeebrugge without transhipment.

NOTICE to terminate all engagements with the workmen have been posted at the Parkside mine, Cleator Moor. It is about 18 months since this mine was taken over by the North Lonsdale Iron & Steel Company, Limited, and the Whitehaven Hematite Iron & Steel Company, Limited, who have now a fusion of interests under the style of the Parkside & Birks Mining Company, Limited.

THE ascertainment for the past quarter, issued by the Cleveland Ironmasters' Association, certifies the average net selling price of No. 3 Cleveland pig-iron at 88s. 4d. per ton, an advance of 2s 9d. per ton on the price for the previous quarter. In accordance with the sliding scale arrangement, blastfurnacemen's wages will be advanced by 2¾ per cent., raising them to 26¾ per cent. above the standard.

THE DIRECTORS OF Fairbairn, Lawson, Combe, Barbour, Limited, announce that a provisional agreement has been reached for the acquisition of shares in Samuel Walker et Cie, makers of textile machinery, of Lille. This firm was established over fifty years ago, and prior to the war was carrying on a substantial and growing business. The works, however, were gutted by the Germans during their occupation of Lille, and their equipment with the most modern machinery is only now reaching completion.

THE BRITISH ELECTRICAL AND ALLIED INDUSTRIES RESEARCH ASSOCIATION, in their annual report, state that the Association continues to co-operate with the British Engineering Standards Association and the committees of the Institution of Electrical Engineers, and has important researches in hand undertaken on the request or suggestion of those bodies. It is hoped at an early date to bring into closer co-operation with the Association the electric supply authorities, power users, their technical advisers and others who benefit by the researches so undertaken.

IRON AND STEEL MARKETS.

Pig-iron.

MIDDLESBROUGH.—Business in the Cleveland iron market, on the whole, continues fairly satisfactory, though buying is by no means on the substantial scale usually experienced in the opening weeks of the New Year, and which had been confidently anticipated as resulting from the revival of interest among home consumers. The uncertainty of the outlook abroad has also had an adverse influence on export trade from Tees-side, which is reflected in the heavy decrease in shipments of iron from the port during the past fortnight, the total tonnage being only about a third of the quantity returned for the corresponding period in December. It is, however, reassuring to learn that the production of pig-iron in 1922 indicated nearly double that of the preceding year for the kingdom, amounting to 4,899,500 tons, as compared with 2,616,300 tons in 1921. The figures just quoted indicate the steady expansion of output, due mainly to a corresponding improvement in home demand, of which Cleveland makers have certainly obtained a very substantial share, both in foundry pig and iron for the steel works. In this market, also, Scotland is again resuming active buying, and some forward business is reported in that direction. At the moment, Tees-side stocks in smelters' yards are practically depleted, both No. 1 and No. 3 quality foundry being almost impossible to obtain for prompt delivery. There are, however, fair qualities available of No. 4 forge and similar grade foundry on hand, but demand for these qualities is not so brisk of late. Price movements reflect this scarcity in the firmer quotations for No. 1 at about 96s. 6d. per ton, No. 3 G.M.B. only to be purchased in small parcels at present at 92s., with No. 4 foundry marked at 85s., No. 4 forge 82s. 6d., with lower grade iron at relative prices.

The Tees-side market for hematite is steady at 93s. for East Coast mixed numbers and 93s. 6d. for No. 1. Export business continues disappointing, but the home trade is active, and the current output is going steadily into consumption, leaving but little stock on makers' hands. The outlook for home consumption is decidedly hopeful, and if the demands from the Continent were to improve, which does not seem very probable in the immediate future, an expansion of output would necessarily follow.

SCOTLAND.—Buying in the Glasgow market has now assumed a much steadier tendency, consumers evidencing more confidence in the future than has been the case hitherto, and although makers are not keen to book forward contracts, merchants are apparently inclined to take orders for deliveries over the next few months. The demand for Scotch iron from abroad also shows an improvement, as, in addition to a general broadening in the demand, America is showing distinct signs of coming into the market again. Several lots of moderate tonnage have been recently sold, and had the sellers been willing to meet the buyers' ideas as to prices the business done would have amounted to several thousand tons. With the rising costs in America and the prospect of more trouble with the miners there, members of the trade are not without hope that a considerable business with America in the near future is within the bounds of possibility.

THE MIDLANDS.—In this district also a more confident feeling is expressed in market circles that the corner has been turned, and an improvement in demand is another encouraging feature in the position, while if the present rate of progress is maintained it will be necessary soon to put on additional furnaces. The chief difficulty in the way of doing so is the scarcity and dearness of cokes and, from all accounts, there is not much prospect of an early alteration in this direction. Of course, smelters with idle furnaces are watching the situation very closely, but so far few of them seem disposed to turn on the blast again. Foundry iron is in increased demand, and prices are very firm.

MANCHESTER.—One of the most encouraging features of the pig-iron position in the Lancashire area is the disposition shown on the part of consumers to enter into forward contracts. Some orders have been recently booked for deliveries, a custom which has been in abeyance for a long time past. This circumstance points to a marked improvement in the local foundry industry, due, it must be assumed, to an increased demand from the engineering and shipbuilding branches. Manchester ironfounders are now being offered Lincolnshire No. 3 in competition with Derbyshire and Northamptonshire. The Derbyshire furnaces —in spite of the lessened consumption of foundry iron —have kept clear of any accumulation, but one reason for this is that they have had the Lancashire market almost entirely to themselves for nearly the whole of the year. The North Lincolnshire furnaces, now being started, are already quoting No. 3 foundry for delivery into Manchester at the same price as that for Derbyshire iron, viz., from 90s. to 91s. per ton, but it is not yet known whether they will concentrate on the production of foundry quality.

Finished Iron.

The quarterly meeting at Birmingham last week was fully representative of the trade in all departments, and from every point of view was the most successful gathering of the kind held for a long time past. There was a distinctly better tendency to place orders for most descriptions of material, encouraged doubtless by increased demand in shipbuilding and engineering sections, and prices were consequently firmer in most departments. Manufacturers' order books, though still leaving much to be desired in the volume of work on hand, show some improvement in bulk, foreign competition in the cheaper qualities of bar material having subsided to some extent owing to the disturbance of exchange conditions abroad. There has been, as anticipated, no change in quotations for marked bars, but unmarked iron was slightly firmer, on the strength of an improved demand and the diminution of foreign competition. Crown iron prices were unchanged, but the nominal quotation was more easily realisable. Nut and bolt iron was quite firm at £9 15s., there being less cutting competition. Gas strip also was reported as having gained some strength from the prevailing conditions. Prices obtainable, though firmer, are still insufficiently remunerative, and there is not enough demand to afford employment for all the plant available. Still, the outlook encourages the hope that values will gradually reach full and profitable employment as the year progresses.

Scrap.

With few exceptions, the principal markets for scrap metal continue to report the increased activity in demand for heavy steel scrap, of which consumers in many districts are now unable to secure adequate supplies. In Lancashire, the demand for foundry scrap, or broken cast iron, is better, and dealers are slightly firmer than they were, but there is rather too large a quantity on the market. The market is, consequently, rather irregular, and one finds differences of as much as 5s. per ton between quotations made in the same district. The ironfounders are, however, now buying foundry pig-iron over the next few months, having satisfied themselves apparently that there is no prospect of lower prices, and with more work in hand they will soon want more cast scrap. Buyers on Tees-side are reluctant to follow recent advances, and sellers are holding out for figures more nearly corresponding with those obtainable in Sheffield and other large consuming areas. The following are approximate current quotations, all delivered works:—Heavy steel scrap, 75s.; steel turnings and c.i. borings, 60s.; cast-iron scrap, machinery quality, 77s. 6d.; heavy wrought-iron piling scrap, 75s.; special heavy forge, 82s. 6d. to 85s. At Sheffield the demand for steel scrap of all kinds is the outstanding feature of the market, and consumers are unable to secure sufficient to meet their requirements. Buyers would be willing to arrange for supplies over a considerable period at somewhat enhanced prices, but sellers are frequently unable to accommodate such business, and in consequence buying is only from hand-to-mouth. For iron scrap there is a slightly better demand, but the interest in steel material dwarfs attention to all other descriptions.

Steel.

Although the year just closed was regarded as an extremely quiet time for the steel industry, it is somewhat of a revelation to discover that production was more than doubled, in comparison with that of 1921, as denoted in the respective totals, the figures being 5,821,900 tons, and 2,616,300 tons for the last-named period. Turning to the present position of the trade it is satisfactory to report increasing activity in most departments of manufacture, Sheffield billet makers, both of basic and acid qualities, having a fair volume of orders in hand, with prices firmer, but without any actual change in quotations. The improvement recently noted in demand for structural and railway material is well maintained, some of the works engaged in the last-named branch which have been idle for a long time restarting this week. In the market for alloys operations are still confined to small dealings. In ferro-manganese, the general situation is changed a little, and with the improvement in the

(*Continued on page* 60.)

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BOILER, SHIP and BRIDGE PLATES, etc. ANGLES and all forms of Sectional Bars. TYRES and AXLES to all requirements. CASTINGS of all kinds and of Largest Sizes. FORGINGS of every description. BILLETS, BLOOMS, RAILS.

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Telegrams: "LOWOOD, DEEPCAR."

IRON AND STEEL MARKETS,—*Continued.*

home steel trade, much better business is being done. On the other hand, the market abroad is not so good, the Continental demand easing off. Prices are unaltered at £15 for home and £14 for export. The tone of the tinplate market continues very firm, and although the official minimum selling price remains unchanged as yet, there are few, if any, works now prepared to accept an order of any size unless at an advance, in some cases of 6d. to 1s. a box basis. The inquiry for plates is good, and buyers are showing a desire to cover their requirements before values go still higher. Quite a lot of "option" business has been fixed up of late, and prices paid were reported round 20s. 6d. basis.

Metals.

Copper.—Due in part to the unsettled political situation abroad, conditions in the standard copper market during the past week have taken a quieter turn, and the business transacted has been relatively unimportant. Buying on home consumptive account has fallen off to some extent, but a revival of demand is shortly expected, the prospects of the manufacturing trades being regarded as favourable to an early expansion in this direction. Official returns give the exports of copper from the United States during the ten months ending October, 1922, as 272,190 tons. Of this total, Germany took the largest quantity with 75,324 tons (of 2,240 lbs.), with France next with 48,938 tons, and the United Kingdom third with 35,017 tons. Of the remainder, 15,282 tons went to Belgium, 12,082 to Holland, and 19,982 to Italy, while China and Japan together took 21,888 tons. Current quotations:—*Cash*: Wednesday, £64 5s.; Thursday, £64 5s.; Friday, £64 2s. 6d.; Monday, £64; Tuesday, £63 10s. *Three Months*: Wednesday, £64 17s. 6d.; Thursday, £64 17s. 6d.; Friday, £64 15s.; Monday, £64 12s. 6d.; Tuesday, £64 2s. 6d.

Tin.—Business in the market for standard tin presents few features of outstanding importance at the moment, but it is satisfactory to note the absence of the erratic fluctuations in values reported in this metal of late. Consumers' demands continue on a somewhat limited scale, and with only partial support from buyers in the States the market has been subject to considerable speculative realisation. With regard to future conditions some extension of the home demand is anticipated, while the Continent also is expected to shortly be taking much larger quantities. Little expansion in the American demand can be hoped for, as domestic consumption in that country is already on a good scale. Current quotations:—*Cash*: Wednesday, £179 7s. 6d.; Thursday, £181; Friday, £181 17s. 6d.; Monday, £181 5s.; Tuesday, £180 17s. 6d. *Three Months*: Wednesday, £181; Thursday, £181 12s. 6d.; Friday, £183 12s. 6d.; Monday, £182 17s. 6d.; Tuesday, £182 10s.

Spelter.—An outstanding feature in the market for this metal of late has been a substantial decline in values, and the backwardation so long in evidence has decreased considerably. Consumers' demands have fallen away to a considerable extent, while the Continental political position has influenced some realisations. Current quotations:—*Ordinary*: Wednesday, £35 15s.; Thursday, £35 12s. 6d.; Friday, £35; Monday, £35; Tuesday, £35 2s. 6d.

Lead.—The market for soft foreign pig maintains its remarkably steady tendency, consumption remaining at a fair average, with supplies still on a limited scale. The American market continues firm, with conditions similar to those prevailing here. Current quotations:—*Soft foreign (prompt)*: Wednesday, £26 15s.; Thursday, £27; Friday, £27 2s. 6d.; Monday, £26 17s. 6d.; Tuesday, £26 15s.

Deaths.

MR. THOMAS WYNN, retired lock manufacturer, of Tettenhall, Wolverhampton, has died as the result of an accident. He was 80 years of age.

MR. WILLIAM CRAMP, the well-known United States shipbuilder, and grandson of the founder of the firm of William Cramp and Son, has died at the age of 91 years.

MR. CHARLES LATHE died recently at his residence, Summerhill House, Coseley, near Bilston, aged 84. He was the principal of the firm of Messrs. Lathe, engineers and ironfounders, Tipton.

CAPTAIN W. D. REED, who recently accepted an appointment to take over the management of Ohlson & Company's Iron and Steel Works at Hull, but was prevented from doing so by illness, has died at South Shields.

Company News.

Bartram & Sons, Limited.—Capital £100,000 in £100 shares. Shipbuilders and repairers.

Fontagene, Limited.—Capital £100 in £1 shares. Ironfounders. Directors: A. H. Pickering and P. A. Garrett.

Clevedon Engineering Company, Limited, The Triangle, Clevedon.—Capital £3,000. Directors: B. E. Dening and H. H. Mathews.

Cleaver Bros., Limited, 37, Howland Street, Tottenham Court Road, London, W.1.—Capital £1,100 in £1 shares. General engineers. Directors: S. Cleaver and W. Cleaver.

F. A. Jones & Company, Limited, 71, Newman Street, London, W.—Capital £750 in £1 shares. Engineers. Directors: Capt. E. A. J. Ferrers and F. A. Jones.

Primrose & Company, Limited, The Albert Foundry, Jane Street, Leith.—Capital £10,000 in £1 shares, to acquire the business of ironfounders, engineers, etc., carried on by Primrose & Company.

Bamford Works, Limited, Tickleholme, Bamford, Derbyshire.—Capital £5,000 in £1 shares. General engineers. Directors: G. H. Smith (chairman), W. H. Smith and J. Davies. Secretary: H. Rhodes.

Morris & Company (Stockwith), Limited, West Stockwith, near Doncaster.—Capital £50,000 in £1 shares (20,000 preference and 30,000 ordinary). Metal extractors. Directors: H. Morris, M. D. Holmes and W. T. Gent.

Dixonia, Limited.—Capital £2,000 in £1 shares (1,000 preferred ordinary and 1,000 ordinary). Engineers, manufacturers of machinery, etc. Directors: L. T. Dixon (managing director), D. Norman and Col. C. T. Brown.

Reliance Iron and Steel (Llanelly), Limited.—Capital £2,000 in £1 shares, to acquire the business carried on by Mary Richards as the Reliance Iron and Steel Company. Directors: Mrs. M. Richards and W. C. Richards.

Thomas Shanks & Company, Limited, Union Iron Works, Mary Street, Johnstone.—Capital £150,000 in 40,000 preference and 110,000 ordinary shares of £1 each. Engineers and machine-tool makers. Directors: W. G. Shanks and C. F. Shanks.

J. W. Barnard & Haynes, Limited, 4, Great Winchester Street, London, E.C.—Capital £3,000. Mechanical and electrical engineers. Directors: J. W. Barnard (permanent chairman and managing director), H. E. Haynes, F. G. Tolley and C. H. Tolley.

Halliday Engineering Company, Limited.—Capital £10,000 in 5,000 first 7 per cent. cumulative preference and 4,500 second 7 per cent. cumulative preference shares of £1 and 10,000 ordinary of 1s. Directors: A. S. Dott, G. H. Hana, T. E. Halliday and A. G. Scholes.

Gazette.

BUYERS OF SCRAP METAL, LIMITED, London, S.E.—It has been resolved that Mr. C. S. Clarke, Glyn Street, Vauxhall, S.E., secretary, be appointed liquidator.

MR. W. H. HOLDEN, 8, Stanley Road, Earlsdon, and trading at 132a, Much Park Street, Coventry, as Universal Fittings Company, engineer, has been adjudicated bankrupt.

MR. R. BROWNLOW, Prospect Villa, Beechen Cliff, Bath, now or late trading as Griffin Engineering Company, Limited, Kingston Iron Works, Bath, and 68, St. James' Street, S.W., engineer, has been adjudicated bankrupt.

TRADING under the style of Ricard & Freiwald, Messrs. C. Ricard and W. E. Earle, 120, Fenchurch Street, E.C., metal merchants, have dissolved partnership. Debts by Mr. C. Ricard, who will carry on the business in partnership with Mr. W. H. Gartsen.

PECKHAM TRUCK AND ENGINEERING COMPANY, LIMITED.—It has been resolved that it being expedient to effect a sale of the company's assets to a new company to be formed under a similar name, Mr. D. Haslett, 26, Audrey House, Ely Place, E.C., accountant, has been appointed liquidator.

MR. G. F. MULHERION, managing director of the Tyne Iron Shipbuilding Company, Limited, Willington Quay, has received many congratulations on his having completed 50 years' association with the shipbuilding industry. Mr. Mulherion was born in London, and commenced his business career with Earle & Company, of Hull. Four years later he joined the staff of the Tyne Iron Shipbuilding Company, which was founded by the late Mr. W. J. Bone. For many years Mr. Mulherion also acted as secretary to the firm.

Telegrams: "THROWER, GLASGOW." Telephone: 5909 CENTRAL.

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SAND BLAST EQUIPMENT. For any Service.

MOULDING MACHINES. Electric, Air and Hand Power.

FORCED DRAUGHT. Core Stove, Furnaces.

PORTABLE CORE OVENS.

CORE MACHINES. Core Compound. Core Oil. Glutrin. Parting Powder. Perforated Chaplets, &c.

BRASS RECOVERY MACHINES. New Process.

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THE BEST BRANDS OF WELSH, LANCASHIRE, DURHAM AND YORKSHIRE COKES.

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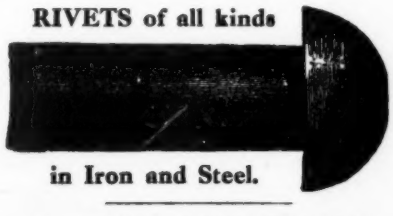
RIVETS of all kinds



in Iron and Steel.

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WEEKLY PRICE CURRENT.

COPPER.

	£	s.	d.
Standard cash	63	10	0
Three months	64	2	6
Electrolytic	70	7	6
Tough	67	10	0
Best selected	67	10	0
Sheets	96	0	0
India	82	10	0
Wire bars	70	12	6
Do. Jan.	70	12	6
Do. Feb.	70	12	6
Ingot bars	70	12	6
H.C. wire rods	75	0	0
Off. aver. cash, Dec.	63	6	9 8/10
Do. 3 mths., Dec.	64	2	9 1/10
Do. Settlement Dec.	63	5	9 9/10
Do. Electro, Dec.	70	6	3 1/10
Do. B.S., Dec.	67	10	0
Aver. spot price, copper, Dec.	63	5	9½
Do. Electro, Dec.	70	10	0
Solid drawn tubes			13½d.
Brazed tubes			13½d.
Wire			10½d.
Yellow metal rods			6¾d.
Do. 4x4 Squares			8¼d.
Do. 4x3 Sheets			9¼d.

BRASS.

Solid drawn tubes	11¾d.
Brazed tubes	13½d.
Rods, drawn	10¾d.
Rods, extruded or rolled	6½d.
Sheets to 10 w.g.	10d.
Wire	9¾d.
Rolled metal	9½d.

TIN.

	£	s.	d.
Standard cash	180	17	6
Three months	182	10	0
English	181	0	0
Bars	183	0	0
Chinese	178	17	6
Straits	182	10	0
Australian	182	5	0
Eastern	185	5	0
Banca	182	2	6
Off. aver., cash, Dec.	178	15	6 6/10
Do. 3 mths., Dec.	180	0	3 1/10
Do. Sttlment, Dec.	178	18	3 5/10
Aver. spot, Dec.	178	14	2½

SPELTER.

	£	s.	d.
Ordinary	35	2	6
Remelted	34	10	0
Hard	28	0	0
Electro 99.9	41	0	0
English	37	0	0
India	29	0	0
Prime Western	37	0	0
Zinc dust	49	0	0
Zinc ashes	11	0	0
Off. aver., Dec.	36	4	11 4/10
Aver., spot, Dec.	37	15	1½

LEAD.

	£	s.	d.
Soft foreign ppt	26	15	0
English	28	0	0
Off. average, Dec.	25	15	9 9/10
Average spot, Dec.	26	1	7

ZINC SHEETS, &c.

	£	s.	d.
Zinc sheets, English	43	0	0
Do. V.M. ex whf.	42	0	0
Dutch	42	0	0
Rods	49	0	0
Boiler plates	41	0	0
Battery plates	42	0	0

ANTIMONY.

	£	s.	d.
English regulus	27	0	0
Special brands	33	10	0
Chinese	24	10	0
Crude	18	5	0

QUICKSILVER.

	£	s.	d.
Quicksilver	11	0	0

FERRO-ALLOYS AND STEEL-MAKING METALS.

	£	s.	d.
Ferro-silicon—			
45/50%	11	17	6
75%	20	10	0

Ferro-vanadium—
35/40% 17/- to 17/3 lb. va.

Ferro-molybdenum—
70/75% c. free 9/3 lb. mo.

Ferro-titanium—
23/25%, carbonless 1/1½ lb.

Ferro-phosphorus, 20/23%, £23

Ferro-tungsten—
80/85%, carbon free 1/5 lb.

Tungsten metal powder—
98/99% 1/11 lb.

Ferro-chrome—

4/6% car.	£22 0
6/8% car.	£21 0
8/10% car.	£20 0

Ferro-chrome—

Max. 2% car.	£54 0
Max. 1% car.	£65 0
Max. 0.70% car.	£73 0
67/70%, carbonless	1/7 lb.

Nickel—99%, cubes or pellets £130 0

Cobalt metal—98/99% 11/3 lb.

Aluminium—98/99% £95

Metallic Chromium—
96/98% 4/6 lb.

Ferro-manganese (net)—

76/80%, loose	£15
76/80%, packed	£16
76/80%, export	£14

Metallic manganese—
94/96%, carbonless 2/3 lb.
Per ton unless otherwise stated.

HIGH-SPEED TOOL STEEL.

Finished bars, 14% s. d. tungsten 2 6
Finished bars, 18% tungsten 3 0
Per lb. net, d/d buyers' works.

Extras—
Rounds and squares 3 in. to 8 in. inclusive 4d. lb.
Rounds and squares under ½ in. to ¼ in. 3d. lb.
Flats under 1 in. by ¾ in. to ½ in. by ¼ in., and all sizes over four times in width over thickness 3d. lb.
Bevels of approved sizes and sections 6d. lb.
If in coils 3d. lb.
Packing £3 ton.
Bars cut to length 10% extra

Scrap from high-speed tool steel—
Scrap pieces 3d.
Turnings and swarf 1d.
Per lb. net, d/d steel makers' works.

SCRAP.

South Wales—	£	s.	d.	£	s.	d.
Heavy steel	4	2	6	4	10	0
Bundled steel & shearings	3	10	0	4	0	0
Mixed iron & steel	3	10	0	3	17	6
Heavy cast iron	3	15	0	3	17	6
Good machinery for foundries	3	15	0	4	5	0

Cleveland—	£	s.	d.
Heavy steel	3	15	0
Steel turnings	3	0	0
Cast-iron borings	3	0	0
Heavy forge	4	3	9
Bushelled scrap	3	15	0
Cast-iron scrap	3	17	6

Lancashire—	£	s.	d.
Cast-iron scrap	4	3	9
Heavy wrought	3	11	3
Steel turnings	2	10	0

London—	£	s.	d.
Copper (clean)	57	0	0
Brass (clean)	33	0	0
Lead (less usual draft)	23	0	0
Tea lead	20	0	0
Zinc	22	10	0
New aluminium cuttings	64	0	0
Braziery copper	48	0	0
Gun metal	44	0	0
Hollow pewter	150	0	0
Shaped black pewter	90	0	0

Above are merchants' buying prices delivered yard.

PIG-IRON.

N. E. Coast—	
Foundry No. 1	96/6
Foundry No. 3	92/-
Forge No. 4	82/6
Mottled	80/-
Hematite No. 1	93/6
Hematite M/Nos.	93/-
Midlands—	
Staffs. common	—
,, part-mine forge	—
,, ,, foundry	—
,, Cold blast, ord.	190/-
,, ,, roll iron	200/-
,, basic	—
Northants forge	72/6 to 75/-
,, foundry No. 3	82/6
,, basic	80/-
Derbyshire forge	77/6
,, foundry No. 3	85/-
,, basic	80/-
Scotland—	
Foundry No. 1	100/6
,, No. 3	95/6
Hematite M/Nos.	105/-
Sheffield (d/d district)—	
Derby forge	85/-
,, foundry No. 3	87/6
Lincs. forge	86/6
,, foundry No. 3	87/6
,, basic	86/6
E.C. hematite	103/3
W.C. hematite	108/9
All d/d in the district.	
Lancashire (d/d eq. Man.)	—
Derby forge	—
,, foundry No. 3	93/6
Northants foundry No. 3	—
Cleveland foundry No. 3	—
Staffs. foundry No. 3	—
Lincs. forge	—
,, foundry No. 3	—
Summerlee foundry	110/6
Glengarnock foundry	114/-
Gartsherrie foundry	112/6
Monkland foundry	110/6

FINISHED IRON & STEEL.

Usual District deliveries for iron; delivered consumers' station for steel.

Iron—	£	s.	d.
Bars (cr.)	£10 10 to 11	10	0
Angles	£10 15 to 11	15	0
Tees to 3 united ins.	£11 to £12		
Nut and bolt	10	2	6
Hoops	14	0	0
Marked bars (Staffs.)	13	10	0
Gas strip	11	0	0
Bolts and nuts, ¾ in. × 4 in.	16	10	0
Steel—			
Ship plates	£9 to 9	10	0
Boiler plates	12	0	0
Chequer plates	10	5	0
Angles	£8 10 0 to 9	0	0
Tees	£9 12 6 to 10	0	0
Channels	8	10	0
Joists	9	0	0
Rounds & squares 3 in. to 5½ in.	11	0	0
Rounds under 3 in. to ⅜ in.	10	15	0
Flats, over 5 in. wide and up	11	5	0
Flats, 5 in. to 1½ in.	10	10	0

	£	s.	d.
Rails, heavy	8	15	0
Fishplates	13	0	0
Hoops	11	0	0
Black sheets, 24 g.	11	15	0
Galv. cor. sheets, 24 g.	18 0 0 to 18	10	0
Galv. fencing wire. 8 g. plain	16	0	0
Rivets, ¾ in. dia.	11	15	0
Billets, soft	6 12 6 to 7	0	0
Billets, hard	7 5 0 to 8	0	0
Sheet bars	7 5 0 to 7	10	0
Tin bars	7	13	9

PHOSPHOR BRONZE.

	Per lb. basis.
Strip	1 3
Sheet	1 3¾
Wire	1 3¾
Rods	1 2¾
Tubes	1 6
Castings	1 1

Delivery 3 cwt. free to any town.
10% phosphor copper, £40 above price of B.S.
15% phosphor copper, £50 above price of B.S.
Phosphor tin (5%), £30 above price of English ingots.

CHARLES CLIFFORD & SON, LIMITED, BIRMINGHAM.

NICKEL SILVER, SHEET METAL, WIRE AND TUBES.

	Per lb.
Ingots for raising	9d. to 1/3
Rolled—	
To 9 in. wide	1/3 to 1/9
To 12 in. wide	1/3½ to 1/9½
To 15 in. wide	1/4 to 1/10
To 18 in. wide	1/4¾ to 1/10¾
To 21 in. wide	1/5½ to 1/11½
To 25 in. wide	1/6½ to 2/0¼
Ingots for spoons and forks	9d. to 1/3
Ingots rolled to spoon size	1/- to 1/6
Wire round—	
3/0 to 10 G.	1/6½ to 2/1½

with extras according to gauge.

AMERICAN IRON & STEEL.

At Pittsburgh unless otherwise stated.	Dols.
No. 2X foundry, Phila.	29.76
No. 2 foundry, Valley	27.00
No. 2 foundry, Birm.	23.00
Basic	26.96
Bessemer	29.27
Malleable	28.96
Grey forge	28.27
Ferro-manganese 80% delivered	100.00
Bess. rails, h'y, at mill	43.00
O.-h. rails, h'y, at mill	43.00
Bess. billets	36.50
O.-h. billets	36.50
O.-h. sheet bars	36.50
Wire rods	45.00
	Cents.
Iron bars, Phila.	2.32
Steel bars	2.00
Tank plates	2.00
Beams, etc.	2.00
Skelp, grooved steel	2.00
Skelp, sheared steel	2.00
Steel hoops	2.75
Sheets, black, No. 28	3.35
Sheets, galv., No. 28	4.35
Sheets, blue an'l'd, 9&10	2.50
Wire nails	2.70
Plain wire	2.45
Barbed wire, galv.	3.35
Tinplate, 100-lb. box	$4.75

COKE (at ovens).

Welsh foundry	35/- to 40/-
,, furnace	25/- to 27/6
Durham & North. fdy.	27/6 to 30/-
,, furnace	26/6
Other Districts, foundry	25/- to 30/-
,, furnace	25/6

SWEDISH IRON.

Bars, hammered basis sizes—Basis price £22 to £23

	£ s. d.
Rolled Ordinary—Assortment ..	17 10 0
Nail Rods—	
Square, round and flats ..	to 18 5 0

Keg Steel nom. £38 to £40
Faggot Steel nom. £30 to £32

Blooms—
Single welded .. £10 to £11

Billets—
Single and double welded .. .. £13 to £14

Pig-iron—
Grey, white or mottled £6 10 to £7 5 0

Prices are without engagement. All quotations are f.o.b. Gothenburg, net cash against documents there.

TUBES.

Up to and incl. 6 in.

Gas ..	..57½%	Tube prices are now free.
Water	..52½%	
Steam	..47½%	

TINPLATES.

I.C.Cokes,	20×14, box	20/6
,,	28×20, ,,	42/–
,,	20×10, ,,	29/9
,,	18¾×14, ,,	21/3
I.X.	,,	47/6
I.X.X.	,,	53/6
F.C.B.Y.	21×13¾ ,,	38/6
C.V.B.G.	16¾×15, ,,	36/6
I.C.W.	20×14, ,,	18/10½
,,	28×20, ,,	37/6
,,	20×10, ,,	26/9
,,	18¾×14, ,,	19/1½
Terneplates,	28×20, ,,	38/–

DAILY FLUCTUATIONS.

Standard Copper (cash).

	£	s.	d.		
Jan. 10	64	5	0	dec.	2/6
,, 11	64	5	0	No Change	
,, 12	64	2	6	dec.	2/6
,, 15	64	0	0	,,	2/6
,, 16	63	10	0	,,	10/–

Electrolytic Copper.

Jan. 10	71	5	0	dec.	5/–
,, 11	71	0	0	,,	5/–
,, 12	70	15	0	,,	5/–
,, 15	70	12	6	,,	2/6
,, 16	70	7	6	,,	5/–

Standard Tin (cash).

Jan. 10	179	7	6	inc.	5/–
,, 11	181	0	0	,,	32/6
,, 12	181	17	6	,,	17/6
,, 15	181	5	0	dec.	12/6
,, 16	180	17	6	,,	7/6

Tin (English ingots).

Jan. 10	179	0	0	No change	
,, 11	181	0	0	inc.	40/–
,, 12	182	0	0	,,	20/–
,, 15	181	5	0	dec.	15/–
,, 16	181	0	0	,,	5/–

Zinc Sheets (English).

Jan. 10	43	0	0	No change	
,, 11	43	0	0	,,	
,, 12	43	0	0	,,	
,, 15	43	0	0	,,	
,, 16	43	0	0	,,	

Spelter (ordinary).

Jan. 10	35	15	0	inc.	5/–
,, 11	35	12	6	dec.	2/6
,, 12	35	0	0	,,	12/6
,, 15	35	0	0	No change	
,, 16	35	2	6	inc.	2/6

Lead (English).

Jan. 10	28	0	0	No change	
,, 11	28	0	0	,,	
,, 12	28	5	0	inc.	5/–
,, 15	28	0	0	dec.	5/–
,, 16	28	0	0	No change	

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THE Lancashire Branch of the Institution of British Foundrymen beg to announce that several members, who have had varied experience as Foremen, etc., are at present disengaged. Employers who are in need of Foremen or other members of their foundry staff are invited to communicate with the Honorary Secretary, T. MAKEMSON, 21, Beresford Road, Stretford, Manchester.

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WANTED.—Assistant Manager for Steel Foundry, light and medium work; young and energetic, up-to-date knowledge of machine practice imperative; electric furnace practice an advantage but not essential.—State salary and experience, Box 320, Offices of the FOUNDRY TRADE JOURNAL, Bessemer House, 5, Duke Street, Adelphi, London, W.C.2.

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